BULLETIN OF THE IMPERIAL INSTITUTE

A RECORD OF PROGRESS RELATING TO AGRICULTURAL, MINERAL AND OTHER INDUSTRIES, WITH SPECIAL REFERENCE TO THE UTILISATION OF THE RAW MATERIALS OF THE DOMINIONS, INDIA AND THE COLONIES

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VOL. XXXV. 1937

CONTENTS

CONTENTS

ARTICLES—*continued*

NOTES

NOTES—*continued*

CONTENTS

ERRATA

Page 334, line 1, *for* Gbobore, *read* Gbobora.

,, 352, ,, 13, *for* J. A. Ward, *read* J. F. Ward.

,, 355, ,, 18, *for* J. H. Ward, *read* J. F. Ward, and *for* Benin, *read* Benue.

,, 356, ,, 6, from bottom, *after* Guinea, *insert* Committee.

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LIST OF ILLUSTRATIONS

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FOREWORD

THE IMPERIAL INSTITUTE: "AN EMPIRE STORY-LAND"

The Exhibition Galleries

AT the Imperial Institute we cover a wide range of responsibilities, from laboratory and intelligence work in the interests of Empire producers, to our Exhibition Galleries, our Cinema and Empire Film Library, our postcards and school specimens. In our Exhibition Galleries a new technique is developing in what might be termed the "Art of Visual Instruction"—the art, that is to say, of arranging and displaying an instructional exhibit in such a way that the attention of the visitor is not merely arrested but held, not merely held but intrigued, and so intrigued that, like Oliver Twist, he asks for more. In fact, the exhibit should induce an interest not solely in itself, but also in the idea behind it, and therefore in the possibility that the other exhibits also are worth studying on the chance that the ideas behind them, too, may be equally novel and intriguing. The clue to the new technique is simply this, that each exhibit:

(*a*) must have a story to tell, and
(*b*) must tell that story simply and yet also purposefully.

Each stage or chapter of the story must lead convincingly from its predecessor to its successor; and the final denouement must carry conviction. The story is not a "worth while" story unless it leads from a simple origin (preferably an origin

so simple that its later developments are not too obvious) through those developments to a finale which strikes some chord of experience in the visitor's mind. The objects displayed may or may not of themselves be outside the run of common human experience, though it is preferable that origin and finale, at least, should be immediately recognised. The novelty and the "intrigue" should lie in the successive stages which link them and in the association of the different objects which unite in sequence to form a single composite whole.

Many different kinds of "story" are possible in a variety of media as wide as the range of human experience. To take one of the simplest examples, the story of an economic product can be told in such a way that it remains a more or less permanent memory. When it is associated with a particular country, then a double purpose is served. The geographical and the economic importance of the product are alike stressed, for the product suggests the country of origin and the country the product.

The Exhibition Galleries of the Imperial Institute are particularly well adapted to stories of this kind. Each of the four Galleries is divided into Courts representing the various countries of the Empire; and the sequence is roughly geographical. From the East Gallery, which appropriately houses India and Ceylon, the visitor enters the South Gallery, comprising Malaya, Borneo and Sarawak, and so passes to Australia, Fiji, New Zealand, the Falkland Islands, the West Indies and Newfoundland to Canada, which fittingly occupies the whole of the West Gallery. From Canada the North Gallery leads through the Mediterranean Colonies of Gibraltar, Malta and Cyprus to Palestine and so to West Africa. South Africa occupies the central position in this Gallery between West and East Africa, whence the Sudan and Somaliland lead to the Seychelles, Mauritius and Aden and so back to Ceylon and India in the East Gallery.

This arrangement provides the proper geographical background. Each Court is provided with its own showcases, dioramas, window transparencies, and so on; and it is here that the "stories" are told. To take one example, in the Uganda Court may be found the story of cotton-seed—a "waste not want not" story, for every scrap of this important

material is utilised. Here a table case has been arranged which shows each successive stage of the industry, from the removal of the first linters for the manufacture of felts, blotting-paper, cellulose products, etc., to the husking of the seed and the use of the husks for tennis court surfaces and other compositions; the crushing of the kernel and all the manifold products derived from the oil and cake, many of them in common use throughout England—for creams and fats, soaps and margarines, lubricants, glycerine, cattle-food, etc. Thus cotton-seed, the commonplace of Uganda, is linked with the domestic and industrial life of England; the Overseas Empire producer with the United Kingdom manufacturer; the knowledge of Empire geography with the lesson of commercial demands and supplies.

A tour round the Galleries of the Institute discloses other stories of this Empire product series. Gambia displays its groundnuts and their uses, Nigeria its palm-oil. Ceylon tells the story of the coconut; India shows how her sheepskins are transformed into London's "kid" gloves, and her kips, or cow-hides, into the traditional army boot; New Zealand lends her rabbit fur to combine with Indian shellac to make the London bowler-hat; the Canadian Court reveals the manifold products and by-products of Canadian nickel ore; South African asbestos and Rhodesian copper have each their own story to tell. It is not to be wondered at that the school-teachers of London and neighbouring counties send their pupils, old and young, to reinforce the text-books of Empire geography with the visual instruction which the Imperial Institute Galleries afford.

One final principle must be stated. It is not enough to show thus in story form the economic products of the Empire. It is equally necessary to show the scenery and weather conditions, the lives and homes of the people who harvest or fell or mine these products; that is the essentially geographical side of the composite stories which the Galleries have to tell. For this reason each Court contributes by photographs, models and dioramas, to a travelogue of the Empire country represented.

If education means anything, it means the training of the human mind to take an interest in events and conditions outside its own immediate orbit. What is this common food

or drink, clothing or utensil of my everyday life? What is its origin? Who produced it and how and where does he or she live and work? Such questions are limitless, but in one form or another they underlie all education in the widest and truest sense of the term. And, more important still, they stimulate that degree of emotional interest which makes the text-book readable and furnishes the right incentive to the geography lesson for teacher and scholar alike. It is just these answers and this emotional interest which the Exhibition Galleries of the Imperial Institute provide.

The Cinema and Empire Film Library

School parties brought or sent to the Imperial Institute by their teachers usually come for a definite purpose fitting in with the school curriculum. If Canada is the subject for the geography lesson of the day, the guide-lecturers take them to the Canadian Court and explain the various exhibits in sequence—agriculture, forestry, dairy-farming, fishing, mining, and so forth, with natural scenery and sometimes climatic and population factors thrown in. But the lesson is not complete without a visit to the Cinema Theatre of the Institute, where Empire films are shown in four daily sessions (two on Sunday afternoons).

The Cinema Theatre was built and bequeathed to the Institute by the Empire Marketing Board, together with the collection of films known as the Empire Film Library. On the demise of the Board this Library had first passed to the Postmaster-General, but it had always been located at the Institute, and in 1935 custody of the films was transferred to the Institute on trust to circulate them gratis (save for costs of transport only) on loan to schools and educational societies of the United Kingdom. The catalogue of the Empire Film Library has been widely distributed, and there are now approximately 2,500 schools and societies which constantly borrow the films. The Library contains over 1,000 films, and the circulation increased from 14,500 in 1934 to 17,500 in 1935 and 24,000 in 1936, which means an aggregate audience of nearly 5,000,000 souls, chiefly school children, who would otherwise have little or no opportunity of seeing the Overseas Empire. With the Empire Film Library the Institute also

handles films of the G.P.O. Film Library and circulates them throughout the United Kingdom.

Films of the Empire Film Library are mostly of the silent variety, for the principal demand from schools is for films of this class. One reason for this preference is, of course, that " talkie " projectors are more expensive than silent, and " talkie " apparatus generally is more complex and requires expert handling. But another, and perhaps the chief, reason is psychological, turning on the degree of concentration necessary for the child-mind to assimilate the story thrown on the screen. Some teachers find that the completely silent film, well captioned, is best ; some advocate the silent film without captions, accompanied by their own running commentary ; some prefer the " talkie " film, though agreeing that the " talkie " requires a preliminary run-through, if not already known, to make sure that the sound accompaniment is suitable to the particular lesson desired—and, indeed, a trial run is necessary for the silent film also, if the teacher is using it for the first time to accompany and illustrate a lecture or talk.

At the Imperial Institute, the " talkie " film is being tried out, as part of the instruction in Empire life, scenery, and industries which the Institute provides, and it will be interesting to see what the verdict of school teachers will be on this experiment, as evidenced by the numbers of the school parties attending the Theatre. It is not unlikely that for some years to come the schools will continue to borrow the silent films of the Empire Film Library for their own use, but will support the Empire " talkie " film in the Institute Cinema. For the weekly lectures given by selected lecturers from various parts of the Empire, each on his or her own country, the silent film undoubtedly provides the best visual accompaniment, varied by lantern slides. A " talkie " film intermittent with the lecturer's own talk, does not produce good results, for the alternation of two different voices is confusing.

Finally, attention is invited to our postcard series and to our school specimen distribution. The postcards illustrate the life, scenery, and industries of the Overseas Empire. We sell them in collections of six cards with a leaflet, and, in some cases, a map as well. The leaflet contains information which may be used as a basis for a school lecture or talk. The

postcards may be used in the epidiascope to accompany and illustrate the lecture. The school specimens comprise specimens of Overseas Empire products not commonly known in this country in their unprocessed form. Both series are becoming increasingly popular with school teachers.

H. A. F. LINDSAY,
Director.

THE IMPERIAL INSTITUTE

SCOPE OF ACTIVITIES

THE Imperial Institute was founded as the Empire Memorial of the Jubilee of Queen Victoria. The purposes of the Institute, as defined by the Imperial Institute Act of 1925, are as follows :—

1. To promote the commercial, industrial and educational interests of the British Empire.

2. To collect and disseminate :—

(*a*) information relating to possible uses of and markets for new raw materials or semi-manufactured products ;

(*b*) information relating to new uses of and markets for already-known raw materials or semi-manufactured products ;

(*c*) information relating to sources, production, supplies, cost, consumption and requirements of raw materials and semi-manufactured products and legislation relating thereto ;

(*d*) information relating to the best means of increasing supplies or of creating new sources of supplies of such materials and products within the Empire ;

(*e*) information relating to the best means of treating such materials and products and of preparing them for marketing ;

(*f*) technical and scientific information bearing upon the industries of the British Empire.

3. To advise on the development of the resources of the Empire in raw materials in order that such resources may be made available for the purposes of industry and commerce and of Imperial defence.

4. To conduct in the laboratories of the Institute preliminary investigations of raw materials and, when it may be deemed advisable, to arrange for more detailed investigation by appropriate scientific or technical institutions.

5. To collect samples of raw materials having a definite value in industry and commerce.

6. To co-operate with other agencies within the Empire formed for similar purposes.

7. To maintain for public information and instruction in the Exhibition Galleries of the Imperial Institute exhibitions illustrative of the resources and development of the Empire and of its scenery, life and progress and where practicable to organise from time to time temporary exhibitions of a similar nature elsewhere.

8. To do anything incidental to or conducive to carrying into effect all or any of the foregoing purposes.

Under the provisions of the Act aforementioned, the Institute was reorganised and placed under the control of the Department of Overseas Trade. The Parliamentary Secretary of that Department is the responsible Minister and is President of the Board of Governors. This body consists of the High Commissioners of the Dominions and India, representatives of the Colonial Office and certain other Government Departments, and of the Crown Agents for the Colonies, with additional members representing scientific and commercial interests. A list of the Board of Governors will be found on p. 13. The Director of the Institute is Sir Harry A. F. Lindsay, K.C.I.E., C.B.E.

The technical work of the Institute is carried out by two principal Departments, viz., a Plant and Animal Products Department and a Mineral Resources Department. An Advisory Council for each of these groups of products has been appointed, Sir Frank Stockdale, K.C.M.G., C.B.E., being Chairman of the Plant and Animal Products Council, and Sir William Larke, K.B.E., Chairman of the Mineral Resources Council.

A number of Advisory Technical Committees consisting of authorities on the various groups of raw materials co-operate in the work of the Institute, in association with the Advisory Councils, and a close touch is maintained with producers, users, merchants, and brokers. Valuable help can thus be given by the Institute to persons interested in the development of raw materials throughout the Empire.

Enquiries.—The Institute maintains a special service for dealing with enquiries relating to the sources, production, uses and marketing of raw materials and for collecting and disseminating general and statistical information on these subjects. This service is available for the use of individuals and firms, as well as of Government Departments.

Investigations.—The laboratories of the Institute are specially equipped for the chemical and technical examination of raw materials of all kinds. Full reports are furnished on the composition, uses and value of materials submitted. By its close association with the users of raw materials, the Institute is able to arrange large-scale trials of promising materials when necessary.

Investigations on plantation rubber are conducted at the Institute under the supervision of the London Advisory Committee of the Ceylon Rubber Research Scheme and the Rubber Research Institute, Malaya.

Charges for Enquiries and Investigations.—Enquiries and investigations are conducted without charge for Governments which contribute to the general revenues of the Institute. In the case of non-contributing Governments fees on a moderate scale are charged for any work involving a considerable expenditure of time and trouble, while simple enquiries and preliminary investigations, easily carried out, are not charged for. Work is carried out for private firms and individuals, at home and overseas, in general on the same terms as for non-contributing Governments.

Library.—The Library of the Institute contains a large collection of works of reference relating to Empire countries and their products and is regularly supplied with the more

important reports and other publications of Government Departments in Great Britain, the Dominions, India, the Colonies and most foreign countries. More than 800 serial publications, mainly of a scientific or technical character, are also regularly received.

The library is available for the use of enquirers between the hours of 10 a.m. and 5 p.m. on week-days (10 a.m. and 1 p.m. on Saturdays).

Statistical Section.—This section is concerned with the collection of statistics required in connection with the work of the Institute.

Publications.—The BULLETIN OF THE IMPERIAL INSTITUTE contains records of the principal investigations conducted at the Imperial Institute, and articles and notes, chiefly relating to progress in tropical agriculture and forestry, the development of mineral resources, and the industrial utilisation of all classes of raw materials. A summary of research work conducted by Government Technical Departments overseas, a special bibliography of publications received in the library of the Imperial Institute and book reviews are also included.

Other publications of the Institute include a handbook on "The Agricultural and Forest Products of British West Africa"; a Descriptive List of Some Empire Timbers; a Report on Grading Rules and Standard Sizes for Empire Hardwoods; a Monograph on the Tanning Materials of the British Empire; Reports on the Collection of Reptile Skins for Commercial Purposes and the Drying of East African Hides; a comprehensive series of some fifty Brochures covering all the important economic minerals and metals under the title of "The Mineral Industry of the British Empire and Foreign Countries"; an Annual Statistical Summary showing production, imports and exports, British and foreign, of all the metals and minerals dealt with in the Brochures; a Survey of the Mineral Position of the British Empire; a series of twelve volumes on the Mining Laws of the British Empire; and one dealing with Mining Royalties and Rents in the British Empire. The Institute also issues series of photographic picture postcards relating to Empire subjects. A list of the publications and postcards is obtainable on request.

Public Exhibition Galleries.—Visitors to these Galleries find each country of the overseas Empire represented by a Court of its own in which the home life, scenery and industries are artistically reproduced by means of photographic transparencies, photographs and dioramas. Where possible these exhibits are so arranged on the principle of the " travelogue " that the visitor is taken in imaginative sequence through just those scenes which would have met his eye had he been making the actual trip. Specimens of economic products are also exhibited; and, where possible, the specimens are grouped so as to tell the story of the industry concerned. By this means the lessons taught in text-books of geography or of technical industry are reinforced by the system which has now come to be known as " visual instruction." Lectures and demonstrations in the Galleries are given daily by the Guide Lecturers.

At the Central Stand, which is situated at a central point in the Exhibition Galleries, free literature relating to Empire countries and products is distributed and Imperial Institute publications and picture postcards are on sale.

In the Exhibition Pavilion attached to the Galleries, temporary exhibitions of a commercial or educational character are held from time to time.

The Galleries are open free on week-days from 10 a.m. to 5 p.m., and on Sunday afternoons from 2.30 to 6 p.m.

Cinema.—The Imperial Institute maintains a Cinema Theatre in the Exhibition Galleries. The Cinema is equipped with standard size projectors and screen, and modern lighting, heating and ventilating systems, and has seating accommodation for 370 persons. Films illustrating life and industries in the various countries of the Empire are shown daily at 10.15, 11.35, 2.15, and 3.35 (Sundays 2.45 and 4.15). Special arrangements are made for visits of organised parties from schools and other institutions. Lectures on industries and countries of the Empire are frequently given in addition to cinema displays.

Empire Film Library.—The Empire Film Library was inaugurated at the Imperial Institute by H.R.H. the Duke of Gloucester on Friday, June 14, 1935. It contains a large collection of cinematograph films depicting industries and agriculture at home and the life, scenery, and products of overseas countries of the British Commonwealth. The films are available for loan to schools and other approved institutions in the United Kingdom without other charge than the cost of their carriage. A revised catalogue of the library is in preparation.

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REPORTS OF RECENT INVESTIGATIONS AT THE IMPERIAL INSTITUTE

Selected from the Reports made to the Dominion, Indian and Colonial Governments

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OIL-PALM FRUITS FROM KENYA

In order to ascertain the possibility of cultivating the West African oil-palm (*Elaeis guineensis*) in Kenya, a small area was planted experimentally with the palm some five or six years ago by the Department of Agriculture at their station at Kibarani in the Coast District, situated 45 miles south of Mombasa. A sample of the fruits produced by these palms was forwarded to the Imperial Institute by the Director of Agriculture in February 1936, and the results of their examination are given in the following pages.

It will be seen that the fruits proved to be of satisfactory quality and palm oil, kernels and cake produced from such fruits, if available in commercial quantities, would be readily saleable in the United Kingdom.

The sample consisted of oil-palm fruits of normal appearance. The fruits varied in size from 0·9 in. long and 0·8 in. broad to 1·3 in. long and 1·4 in. broad, being mostly 1·2 in. long and 1·3 in. broad. The pericarp varied in colour from pale orange to dark reddish-brown. The nuts were thick-shelled and contained generally one kernel, though a number had two.

The fruits were examined with the following results:

Fruits		
Average weight	*grams*	7·6
Pericarp	*per cent.*	32·6
Shell	,,	51·4
Kernel	,,	16·0
Nuts		
Average weight	*grams*	5·1
Shell	*per cent.*	76·3
Kernel	,,	23·7

Kernels		
Average weight	*grams*	1·2
Moisture	*per cent.*	7·6
Oil in kernels as received	,,	52·3
Oil expressed on moisture-free kernels	,,	56·6
Pericarp		
Moisture	*per cent.*	2·5
Oil in pericarp as received	,,	77·5
Oil expressed on moisture-free pericarp	,,	79·5

Pericarp Oil.—The oil extracted from the pericarp with light petroleum was a soft, bright orange fat of the normal appearance of palm oil. On analysis it gave the following results, which are shown in comparison with those recorded for commercial palm oil :

		Present Sample.	Commercial Palm Oil.
Specific gravity at 100° C./15·5° C.		0·8538	0·8586–0·8600
Melting point		30·1° C.*	20°–40° C.
Refractive index at 40° C.		1·456	1·4510–1·4587
Acid value		63·1	4–170
Saponification value		200·2	197–202
Iodine value (Wijs, ½ hr.)	*per cent.*	53·7	49–57
Unsaponifiable matter	,,	0·5	0·5–2·0
Solidifying point of fatty acids		44·6° C.	43°–45° C.

* *Open tube method.*

Kernel Oil.—The oil extracted from the kernels with light petroleum was a soft white fat of the usual appearance of palm kernel oil. It was examined with the following results, which are shown in comparison with those recorded for commercial palm kernel oil and with the requirements of the British Standard Specification for crude palm kernel oil :

	Present Sample.	Commercial Palm Kernel Oil.	British Standard Specification.
Specific gravity at 100° C./15·5° C.	0·8669	0·859–0·871	—
Melting point	27·4° C.*	21°–24° C.	—
Refractive index at 40° C.	1·450	1·4495–1·4506	1·449–1·451
Acid value	2·6	1·4–28·0	Not more than 16·8
Saponification value	249·0	246–249	242–252
Iodine value (Wijs, ½ hr.), *per cent.*	15·4	14·5–19·0	14–19
Unsaponifiable matter ,,	0·3	0·2–0·8	—
Soluble volatile acids**	5·6	5·2–6·5	—
Insoluble volatile acids**	10·6	9·7–10·7	—
Solidifying point of fatty acids	24·4° C.	20°–29·5° C.	—
Colour in a 1 in. cell : Red	0·1	—	Not more than 1·3
Yellow	0·1	—	Not more than 20

* *Open tube method.*

** *Number of cc. of decinormal alkali required to neutralise the acids from 5 grams of oil.*

Palm Kernel Meal.—The residual meal left after the extraction of the kernels with light petroleum was a pale buff-

coloured powder of mild flavour. It was analysed with the following results, which are shown in comparison with those recorded for commercial palm kernel meal :

	Present Sample.	Recorded figures for commercial extracted palm kernel meal (expressed on a basis of 7 per cent. of fat).
	Per cent.	*Per cent.*
Moisture	11·1	10·1
Crude proteins	15·7	18·1
Fat	6·9	7·0
Carbohydrates, etc. (by difference)	51·3	46·5
Crude fibre	11·6	14·6
Ash	3·4	3·7
Nutrient ratio	1 : 4·3	1 : 3·5
Food units	108	109

The results of examination show that the present palm fruits from Kenya were of normal size and appearance, and contained satisfactory proportions of pericarp and kernels. The composition of the fruits is similar to that of palm fruits from Nigeria, whilst they contained less pericarp and a higher percentage of kernels than those from Malaya.

The pericarp contained slightly more oil (expressed on the moisture-free material) than is usually found in the pericarp of Nigerian fruits, and an amount equal to that contained in the pericarp from Malayan fruits.

Commercial Value

The oil from the pericarp (palm oil) was of normal character, and if prepared from similar fruits on a commercial scale it should be readily saleable at the current price of palm oil, which at the date of the report (June 1936), was quoted in Liverpool at £15 5*s*., £15 10*s*. or £18 per ton, according to whether the oil was "soft," "medium" or "hard"; this depending on the mode of preparation.

The kernels contained a satisfactory percentage of oil, commercial consignments usually containing from 46 to 53 per cent. According to the terms of the Incorporated Oil Seed Association Contract for West African palm kernels, shipments are sold on a basis of an oil content of 49 per cent.; any deficiency in oil content is allowed for by the sellers, and any excess paid for by the buyers, on the basis of 1½ per cent. on the contract price per ton for each 1 per cent. under or over

49 per cent., or proportionately for any fraction thereof. The market quotation for palm kernels in June 1936, was £9 10*s*. per ton in Liverpool, and on this basis the present Kenya kernels would be worth £9 19*s*. 6*d*. per ton.

The oil prepared from the kernels was of normal character and fulfilled the requirements of the British Standard Specification for crude palm kernel oil. It would realise the current price of crude palm kernel oil, viz., £20 15*s*. per ton in Liverpool (June 1936).

The residual meal from the kernels contained slightly less crude proteins than is usually found in commercial palm kernel extracted meal, but in other respects it was normal. It would be saleable at a price of about £5 10*s*. to £5 15*s*. per ton in Liverpool.

GRANADILLA (PASSION FRUIT) SEED FROM KENYA

THE cultivation of the granadilla or passion fruit (*Passiflora edulis*) for the production of fruit juice is making good progress in Kenya. With the increasing output of the juice there will be an accumulation of seed and at the suggestion of Mr. E. N. Lanyon, of Kamasega, Sotik, a quantity of the seed was supplied to the Imperial Institute by the Director of Agriculture in August 1936, in order to ascertain its possible value as a source of oil.

The sample consisted of very small, flat, oval seeds, about 0·2 in. long and 0·15 in. broad. The colour was generally very dark greyish-brown, but some seeds were almost black. The seeds were composed of a thin, brittle, woody shell which externally had a pitted surface. The shell surrounded a soft, white, oleaginous kernel. On pounding the seeds a slight fruity odour was observed. The weight of 100 seeds was 9·5 grams.

The seeds were found to contain 8·5 per cent. of moisture, and yielded on extraction with light petroleum 22·4 per cent. of oil, equivalent to a yield of 24·5 per cent. expressed on the moisture-free material. The oil thus produced was pale yellow and became slightly opalescent on standing. On being exposed to the air in a thin film for several days the oil did not dry.

On examination the oil yielded the following results:

Specific gravity at 15·5° C./15·5° C.		0·9261
Refractive index at 20° C.		1·4761
Acid value		0·3
Saponification value		190·9
Iodine value (Wijs, 1 hr.)	*per cent.*	141·2
Unsaponifiable matter	„	0·8

The residual meal left after the extraction of the seeds with light petroleum was pale buff, with a large number of dark-coloured specks due to the shell, and possessed no taste. It was examined with the following results:

	Meal as prepared.	Expressed on meal containing 7 per cent. of oil.
	Per cent.	*Per cent.*
Moisture	11·0	10·2
Crude proteins	12·1	11·3
Oil	0·1	7·0
Carbohydrates, etc. (by difference)	19·2	17·9
Crude fibre	56·0	52·1
Ash	1·6	1·5
Nutrient ratio	1 : 1·6	1 : 3·0
Food units	50	64

The meal was free from alkaloids and cyanogenetic glucosides.

The results of examination show that these granadilla seeds contain only a moderate amount of oil. The oil, which belongs to the "semi-drying" class of vegetable fatty oils, could be employed for soap-making, and would probably be suitable for edible purposes after refining. After the addition of suitable "driers" it might find a use as a low-quality paint oil. The residual meal, however, could not be employed for feeding purposes on account of the very high proportion of crude fibre which it contains, and it might be difficult to dispose of as a fertiliser.

The seeds would not find an outlet as an oilseed on the United Kingdom market on account of their moderate oil content and the very low value of the residual meal. If, however, the quantity of the seeds available in Kenya would warrant their exploitation, they might be crushed, or extracted with a solvent, and the resulting oil, which would be worth about £30 per ton in London (December 1936), offered on the market.

VETIVER OIL FROM JAMAICA

In October 1935 a small sample of vetiver oil prepared by a planter in Jamaica was forwarded to the Imperial Institute. The oil possessed a fairly good odour, but its strength was inferior to that of the more viscous oil distilled in Europe from imported vetiver roots and more resembled the vetiver oil produced in Réunion. The amount of oil available was insufficient for examination or commercial valuation, but from an inspection of the oil the sample appeared to be of a quality that should be marketable in this country. In order to obtain a more definite opinion on the value of the oil a larger sample was subsequently submitted to the Institute and an account of its examination is given below.

The sample of oil as received was somewhat turbid owing to the presence of moisture. On filtration through anhydrous sodium sulphate a clear, rather dark reddish-brown, somewhat viscous oil was obtained. On examination the oil furnished the following constants, which are shown in comparison with the corresponding figures recorded (*a*) for oil distilled in Europe from imported vetiver roots, and (*b*) for oil distilled in Réunion (Bourbon), which is the principal vetiver oil on the London market:

	Present oil.	European-distilled oil.	Réunion-distilled (Bourbon) oil.
Specific gravity at 15·5 C./15·5° C.	0·9970	1·014 to 1·042	0·990 to 1·020
Optical rotation α_D	+17·8° at 19° C.	+25° to +40°	+14° to +37°
Refractive index n_D20° C.	1·5243	1·520 to 1·524	1·515 to 1·529
Acid value	15·5	25 to 65	4·5 to 17
Ester value	10·6	10 to 25	5 to 20
Ester value after acetylation	117·9	130 to 160	119 to 145

These results show that the constants of the oil agree with those of commercial Réunion (Bourbon) vetiver oil. The odour closely resembled that of the small sample furnished earlier and the oil had a similar viscosity, but (as in that case) the odour is not so strong nor so satisfactory as that of the vetiver oil distilled in Europe from imported roots and more resembled that of the Réunion product.

The oil was submitted to two firms of essential oil distillers and a firm of perfumers and soap manufacturers, who furnished the following observations respectively:

Essential Oil Distillers.—(*a*) "We find the odour quite satisfactory. It differs somewhat from that of the Java and Bourbon vetivers, having in our opinion a distinct cinnamon note. We think that the oil should find a ready market and should compete with the Java and Bourbon oils."

(*b*) "The sample has a strange foreign smell, but after that smell has gone off, the truer, lasting smell of vetiver comes out. On the whole, we consider the oil rather superior to the Java or Bourbon oils and we think it should be a useful article in the perfumery trade."

Both firms expressed a wish to be put in touch with the producer with a view to purchasing supplies of oil, and it was suggested that he should communicate with them when he has commercial quantities to offer.

Perfumers and Soap Manufacturers.—"We think the perfume of this sample is very good. It is nearly equal to the Indian oil of vetiver, so near in fact that any perfumer might reasonably use it in place of the Indian oil. We think it is definitely superior to the Réunion vetiver, which it could easily replace.

"We do not think vetiver oil is used in any large quantities by the perfumery trade; vetiver acetate is, however, becoming increasingly popular, and this is at present made only on the Continent from Réunion vetiver."

It will be seen that this sample of vetiver oil from Jamaica was of very satisfactory quality. It compared favourably with the commercial Bourbon (Réunion) oil and should command a similar price. At the date of the report (April 1936) Bourbon vetiver oil was quoted in London at 38*s*. 6*d*. per lb., spot, or 30*s*. 6*d*. per lb., c.i.f., ; the Java oil was quoted on the same date at 17*s*. per lb., c.i.f., London. Since then the price has fallen and in January 1937, Bourbon vetiver oil on spot was available in London at 27*s*. to 30*s*. per lb., with shipment at 22*s*. 6*d*., c.i.f.

The vetiver oil distilled in the United Kingdom from imported roots has a somewhat stonger and more satisfactory aroma than the present sample, and realises a higher price than the Bourbon oil.

The following statement relating to the methods of distillation, yield and uses of vetiver oil was furnished for the guidance of the Jamaica producer.

Methods of Distillation

The distillation of vetiver roots presents special difficulties owing to the high boiling point of the oil and its low volatility with steam, and also to its viscidity. In practice, distillation has to be continued for a long time, 12 to 16 hours or more being commonly found necessary. The roots can be distilled while fresh, or they can be dried first. In the former case they should be thoroughly crushed between rollers before distillation, and in the latter case they should be ground to a coarse powder. In Réunion, the fresh roots are stated to be macerated in water for a night, sometimes with the addition of salt to the extent of 5 per cent. of the water used, which also has the effect of raising the temperature at which distillation is carried out. The separation of the distilled oil from the water accompanying it is a troublesome business, owing to the viscidity of the oil and to the fact that its specific gravity is approximately the same as that of water.

Further information on the subject is given in an article entitled " Vetiver Oil: Notes on an Important Java Production on Modern Lines," which appeared in the *Perfumery and Essential Oil Record*, October 1925, pp. 371-372.

At the Imperial Institute, where numerous experimental samples of vetiver roots received from various countries of the Empire have been distilled, the air-dried roots as received are first reduced to a fairly fine powder and the amount to be distilled soaked in water overnight in the still before distillation the following day. The steam still employed is fitted with a mechanical stirrer with a view to keeping the contents in continual agitation during the distillation, and to enable the steam to pass readily through the material without the formation of steam pockets. To assist in the more ready separation of the oil, the cooled aqueous distillate is allowed to pass through a layer of petroleum ether (boiling point up to 50°C.) contained in the receiver. The last traces of the solvent are subsequently removed from the oil by heating it to 100°C. under reduced pressure.

Yield of Oil

The yield of oil varies considerably. Air-dried roots distilled at the Imperial Institute have furnished from 1·2 to 3·3 per cent., but some recorded yields are as low as 0·5 per

cent. or even less. According to the article referred to above the yield obtained in Java is from 2 to 3 per cent. and it is mentioned that 4 per cent. could be obtained by prolonging the distillation and increasing the steam pressure, but such a yield is stated to be uneconomical. It will be found in every case that a point will be reached beyond which the oil obtained no longer pays for the cost of the distillation.

Use of the Oil in Perfumery

The persistent odour of vetiver oil renders it of the greatest value as a fixative. Traces are sufficient for the rose and opoponax types of perfume, whereas much larger amounts may be employed in conjunction with patchouli as a basis of perfumes of Oriental type. Some useful practical notes on the uses of vetiver oil in perfumes are given in the *Perfumery and Essential Oil Record*, July 1929, pp. 226-228.

ARTICLES

TEXTILE FIBRES OF VEGETABLE ORIGIN: FORTY YEARS OF INVESTIGATION AT THE IMPERIAL INSTITUTE[1]

By ERNEST GOULDING, D.Sc., F.I.C.

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THE Imperial Institute was founded by public subscription as a permanent memorial of Queen Victoria's Jubilee in 1887. One of the principal functions it was designed to fulfil was that of assisting in the development of the natural resources of the countries of the British Empire. In pursuance of this aim a Scientific and Technical Department was established in 1894 and provided with large, well-lighted laboratories where the chemical composition and properties of raw materials of all kinds could be investigated.

From its earliest days the work of the Institute has been seriously hampered by lack of funds. There has therefore

[1] The Mather Lecture of the Textile Institute, 1936. Reprinted from *The Journal of the Textile Institute*, 1936, **27**, No. 6, by kind permission of the Publications Committee of the Textile Institute.

been only a comparatively small staff available for investigational work and for this reason it has been ruled that no research of an academic or fundamental character may be undertaken, but that the work should be restricted to problems likely to yield results of direct practical application.

In this lecture I am attempting to give some account of the work carried out during the last forty years in connection with the investigation of vegetable textile fibres. In the course of that period some thousands of samples have been examined, emanating from all parts of the British Empire as well as from many other countries.

Some of these samples have represented fibres derived from indigenous wild plants met with by agricultural officers or others in the country of origin—fibres which had not been examined previously but which it was considered might possibly be suitable for use in industry. Such fibres were examined in the Institute's laboratories to determine their chemical and physical characters and then, if found to be at all promising, were submitted to commercial experts for an opinion as to their suitability for industrial uses, their marketability and the prices they would be likely to realise.

Other samples have represented fibres already known to commerce but grown experimentally in a new country with a view to determining whether such crops could be introduced on a large scale to form the basis of an agricultural industry.

Other samples again have been submitted to the Institute as resulting from experiments undertaken with the object of improving the quality and value of fibre crops already under cultivation. Such experiments may have been directed to a study of the effect of some particular method of extracting a fibre or of some special treatment adopted in its preparation, or of the effect of special conditions of cultivation.

Investigations have also been carried out in relation to the comparative tensile strength of different fibres and the rate of deterioration of the strength on exposure to fresh or salt water, whilst yet other work has been concerned with the influence of storage conditions on the quality, composition, and strength of the materials.

In the course of this lecture illustrations will be given of investigations of all the types mentioned. In some cases, fuller details of the work have been published in the BULLETIN

and other publications of the Imperial Institute, and in all cases further information could be readily obtained on application to the Institute.

Much of the more recent work has been helped and encouraged, and, in some cases, initiated by the Institute's Advisory Committee on Vegetable Fibres which, since its formation in 1926, has been ably presided over by Mr. Alfred Wigglesworth.

COTTON

At the beginning of the present century the danger to which the British cotton industry was exposed by its dependence on the United States for its raw material led manufacturers to consider the possibility of obtaining supplies from other sources, and in 1901, at the annual dinner of the Oldham Chamber of Commerce, an important discussion took place on the necessity of securing increased supplies for Lancashire spinners. At a subsequent meeting a special Committee was appointed which at once proceeded to make enquiries into the possibilities of cotton-growing in countries of the British Empire. As an outcome of these negotiations the British Cotton Growing Association was inaugurated in June 1902. The movement received the support of H.M. King Edward VII, who in his speech from the Throne on February 2, 1904, said: "The insufficiency of the supply of the raw material upon which the great Cotton Industry of this country depends has inspired me with deep concern. I trust that the efforts which are being made in various parts of My Empire to increase the area under cultivation may be attended by a large measure of success."

From this time forward a large amount of work on cotton was carried out at the Imperial Institute with the aid of a special grant of £2,000 from the Treasury, to be spread over the four years 1905-1908, and a special assistant with a thorough knowledge of textile research was added to the staff. This assistant was Mr. F. W. Barwick, now Director of the Manchester Chamber of Commerce Testing House and Laboratory and an eminent Fellow of the Textile Institute.

Work accomplished by the Imperial Institute from that time forward included not only the examination of the quality and defects of specimens of cotton from nearly all the

Governments of the tropical Colonies and Protectorates as well as from spinners and the preparation of reports and recommendations thereon, but in addition the conduct of special investigations connected with such collateral subjects as the best method of disinfecting cotton seed, the identification and control of insect and fungus pests which attack the cotton plant, and the analysis of soils. Such work was continued until 1914 when, naturally, some interruption was caused by the war. After the war the assistance of the Institute was in less demand owing to the formation of the British Cotton Industry Research Association in 1919 and the establishment in 1921 of the Empire Cotton Growing Corporation.

In recent years the Institute has been able to co-operate to some extent with the Corporation, especially in relation to experiments on rotation crops for cotton which have been carried out at the Corporation's Plant Breeding Station at Barberton, Transvaal. In this connection the Institute has analysed a large number of samples, representing different parts of plants produced in the course of an investigation to ascertain the amounts of plant-food constituents removed from the soil by each crop of a rotation.

Flax

Attempts which have been made from time to time to test the possibilities of flax production in countries of the British Empire have been carefully followed at the Imperial Institute and assistance has been rendered by the examination of samples and the furnishing of advice on the cultivation and preparation of the fibre.

One of the most interesting of these attempts is that which was made in Kenya Colony. In 1907 a sample of flax was examined which had been grown experimentally at the Government Farm at the Kabete in Kenya Highlands at an elevation of about 5,600 ft. Although the fibre had been injured by overretting, its quality indicated that with proper treatment good flax could have been obtained, and it was therefore recommended that experiments should be continued. Further specimens received at intervals showed that progress was being steadily maintained. In 1913 four samples were examined and were found to resemble a standard specimen of Belgian flax in composition and in the character and dimensions

of the ultimate fibres. These flaxes were regarded by the trade as of good medium quality, being superior to Russian and more comparable with the Belgian grades. About this time the services of a Belgian flax expert were secured and rapid developments ensued. A number of factories were erected and flax exported to England realised the price ruling for the higher grades. In order to encourage the enterprise the Department of Agriculture prepared a pamphlet on flax cultivation, treatment, and grading, and distributed it to the settlers. A Government system of grading was introduced, and the industry developed rapidly until 1921, when about 25,000 acres of flax were harvested. Subsequently, however, flax-growing gradually became less popular and the area devoted to the crop rapidly decreased, until in 1925 it amounted to only 552 acres, and soon afterwards the industry almost disappeared. This was due to the fall in the price of flax, the high cost of production caused by the increasing cost of labour, and the difficulty of obtaining a sufficient labour supply for harvesting and retting. The experience gained during the brief life of the industry has proved that flax of excellent quality can be grown in the Kenya Highlands, but that under present conditions its production is not remunerative.

Some attention has also been given by the Imperial Institute to the possibility of developing a flax industry in Cyprus. The flax plant has been cultivated in the Island from early times, but mainly as a source of linseed. In 1907 samples of flax straw and fibre were received from Cyprus and submitted to examination. The fibre was found to be rather hard and lacking in spinning quality, and suggestions were therefore made for improving the cultivation of the crop and the treatment of the straw. It was not until 1923, however, that a definite endeavour was made to induce the villagers to undertake the production of the fibre on a commercial scale. A Russian expert was then employed by the Government to assist in the development of the industry, and some very satisfactory flax was produced.

In 1928 an officer of the Department of Agriculture, Northern Ireland, visited Cyprus at the instance of the Empire Marketing Board to enquire into the possibilities, and his report was considered by the Institute's Vegetable Fibres Committee and recommendations were made.

In spite of these efforts, accompanied by financial assistance afforded by the local Government and the Empire Marketing Board, the production of fibre for export has not shown any marked increase. The total annual production of flax during recent years has amounted on the average to about 150 tons, and most of this is absorbed locally. It is now considered that although excellent flax can be produced in Cyprus it is unlikely that an export industry will be developed, and it is felt that further public expenditure in this direction would not be justified.

In connection with the subject of flax reference may be made to enquiries received at the Imperial Institute regarding the possibility of utilising the fibre contained in linseed straw, enormous quantities of which are produced in the Argentine and other linseed-growing countries. After the linseed has been harvested the plants are usually destroyed by burning. This appears to be a very wasteful procedure as the straw contains much useful fibre. Many attempts have been made to extract this fibre in a suitable form for the flax spinner, but the product obtained has been composed of short coarse strands, and is consequently of comparatively little value. During recent years, however, the Imperial Institute has been consulted concerning processes which have been devised for treating linseed straw in such a way as to extract the fibre in the form of its ultimate elements. These are called "cottonisation" processes, as the ultimate flax fibres obtained are rather more than an inch long and can be spun either alone or mixed with cotton on ordinary cotton machinery slightly modified for the purpose. One such process, invented in Germany, has been applied to the manufacture of fabrics termed "half-linen," which consist of a mixture of "cottonised" flax and cotton. A specimen of this "half-linen" was examined at the Imperial Institute some years ago and found to consist of cotton and flax fibres in approximately equal proportions, the warp and weft being both of the same composition. It is understood that this process is now being worked by an important manufacturing firm in this country.

HEMP AND SUNN HEMP

Very little true hemp, the fibre of *Cannabis sativa*, is produced within the British Empire, and, for this reason, no

work on it has been done at the Imperial Institute, with the exception of the determination of the quality of occasional samples received from Cyprus and elsewhere.

There is, however, in India a fibre, known as Sunn hemp or Sann hemp, which is derived from a Leguminous plant, *Crotalaria juncea*, and is exported in fairly large quantities. It finds a market as a substitute for true hemp, especially the Russian grades, but its consumption has been limited owing to the great irregularity in its quality, the excessive amount of dust and dirt often present in it, and the unsatisfactory manner in which it is graded and packed. In 1926 the Advisory Committee on Vegetable Fibres of the Imperial Institute, at the request of the Royal Commission on Agriculture in India, furnished a memorandum pointing out the defects of the fibre as then exported and making suggestions for overcoming them. In the following year the Committee gave evidence before the Royal Commission, and it would appear that their representations produced some effect, as the imports of fibre soon began to show a decided improvement.

In connection with the efforts of the Imperial Institute to encourage such improvement a Memorandum on " Indian (Sunn or Sann) Hemp : its Production and Utilisation " was prepared at the Institute, published by the Empire Marketing Board (*E.M.B. Publication* 25), and widely distributed both in this country and in India. The suggestions made by the Vegetable Fibres Committee were considered later by the Imperial Council of Agricultural Research in India, and in 1930 a special expert (Mr. T. S. Sabnis) was appointed to make enquiries and report to the Council as to the manner in which improvements might be effectd. His report, entitled " Hemp Marketing in India," was fully discussed by the Imperial Institute Vegetable Fibres Committee, and their observations and recommendations were communicated to the authorities in India. The Committee expressed the opinion that in order to improve the Sunn hemp industry co-operative effort would be required between those engaged in the three sections of the industry, viz. : (1) cultivation and preparation in India ; (2) marketing and shipping at the Indian port ; and (3) reception and distribution of the fibre in importing countries.

In 1929 the Director-General of Commercial Intelligence at Calcutta initiated an enquiry into the effect of the period

of duration of retting on the strength of Sunn hemp, and the Vegetable Fibres Committee suggested that samples retted for three, four, and five days respectively might be obtained from India so that their relative strengths could be compared. A large number of samples (from Bengal, Bombay, Central Provinces, and Madras) were accordingly prepared and forwarded to the Imperial Institute for examination. The matter was taken up with great thoroughness in the Central Provinces, and the Director of Agriculture (Mr. F. J. Plymen, C.I.E.) attended a meeting of the Committee at which the whole matter was discussed. Detailed reports on the examination at the Imperial Institute of the samples from the Central Provinces (numbering 358) were prepared and transmitted to India, together with commercial reports on the same samples kindly furnished by Messrs. Wigglesworth & Co., Ltd. General remarks and conclusions based on the whole of the results were also forwarded. It was pointed out that the differences in the strength and quality of the samples could not be attributed entirely to the variation in the period of retting, but were to no small extent due to differences in the treatment of the stalks before retting and in the treatment of the fibre after withdrawal from the retting water. It was therefore impossible from these investigations to draw very definite conclusions as to the most satisfactory conditions for the preparation of Sunn hemp. The results indicated, however, that, in general, a retting period of from four to six days is desirable, and that retting usually proceeds more rapidly in stagnant water than in flowing water of the same temperature. They also showed that, provided that the temperature is not below 70° F., no advantage is gained by retting for more than five days in tanks, and that for the same retting period in flowing water the temperature should be rather higher to secure the same effect.

In 1928 a further investigation of Indian (Sunn) hemp was directed to the determination of its resistance to the action of water in comparison with that of true hemp. This work was undertaken with the object of ascertaining the accuracy or otherwise of the opinion then commonly held in manufacturing and trade circles that Indian hemp is much inferior in this respect to the European hemps. A few pounds of twine, of the same diameter and made under the same

conditions from Italian, Russian, and Indian hemp respectively, were kindly provided by a firm of manufacturers. Portions of each of these were submitted to alternate wetting and partial drying, and their breaking strains were determined after 40, 80, and 160 days of such treatment in both sea water and fresh water. The results were published as an appendix to the Memorandum on "Indian (Sunn or Sann) Hemp" (*E.M.B. Publication* 25). They showed that before immersion the Italian hemp twine was the strongest and the Indian the weakest. The results of the immersion tests were unexpected and remarkable. In every test in the sea-water the Indian hemp twine suffered a smaller reduction of strength than the others, although the average decrease per cent. of the original strength was approximately the same in all cases. The results of the fresh-water tests were somewhat similar. At the end of each period the actual loss of strength suffered up to that point by the Indian hemp twine was less than that of either the Italian or Russian hemp twines. A comparison of the percentage decreases showed that on the whole the Indian hemp twine resisted the action of fresh water better than either of the others. At a later date in the course of a study of the suitability of Empire fibres for marine cordage (which will be referred to subsequently in connection with Sisal) a trial was made of the comparative behaviour of 3-in. ropes made of Indian hemp and Russian hemp when immersed in sea-water, and here again the Indian fibre proved slightly superior to the Russian.

Before leaving the subject of Indian Sunn hemp reference may be made to an interesting investigation, carried out at the suggestion of the Advisory Committee on Vegetable Fibres, with the object of ascertaining the extent to which the strength of the fibre is liable to vary with the grade. Three bales of Benares Sunn, of grades 1, 2, and 3 respectively, were obtained and forwarded to a well-known firm of manufacturers who kindly converted them into 1-lea polished twines. The products (as is usual with such twines) showed some irregularity in diameter. They were submitted to tensile tests to determine their breaking strains. The results of a number of tests were as follows :—

	Breaking Loads		
	Twine No. 1.	Twine No. 2.	Twine No. 3.
	lb.	*lb.*	*lb.*
Maximum load . . .	133·0	105·0	84·0
Minimum load . . .	90·0	58·0	47·0
Average load . . .	111·1	84·0	62·5

4

These results showed that the three grades of commercial Benares Sunn used for the experiments varied widely in tensile strength, that of the twine made from No. 2 being about three-fourths of that from No. 1, whilst the twine made from the No. 3 grade was only a little more than half as strong as that from No. 1. The particulars furnished by the spinners showed, moreover, that the loss in working up the fibre of No. 3 grade was about twice as great as in the case of Nos. 1 and 2. The total losses recorded in the manufacture of the twines were: No. 1, 21 per cent.; No. 2, 24 per cent.; No. 3, 46 per cent. It would seem, therefore, that the purchase of low-grade Sunn hemps for manufacturing purposes is a doubtful economy.

In 1931 the Department of Agriculture in Uganda commenced a series of trials with Sunn hemp at the Serere Experiment Station, and in the following year 26 samples of the fibre were forwarded to the Imperial Institute as representing the results of experiments in which different quantities of seed had been sown per acre and differing conditions of stripping and retting had been employed. It was desired to ascertain (*a*) the value of the materials in comparison with standard grades of Indian Sunn hemp and (*b*) the combination of treatments which yielded the best fibre. Detailed examination and valuation of the samples indicated (1) that fibre from stems stripped immediately after retting was better than that from stems stripped three days after retting; (2) that under the conditions of the experiments, five days retting proved better than a shorter or longer period; (3) that no obvious advantage had accrued from a longer period of growth than 108 days; and (4) that a seed-rate of 60 lb. per acre had proved on the whole preferable to rates of 40, 50, or 90 lb. per acre. Many of the samples represented fibre which would be readily saleable but at prices rather lower than those ruling for the better grades of Indian Sunn.

In 1934 further samples were received at the Imperial Institute which represented the results of attempts made by the Uganda Department of Agriculture to devise a chemical process for the preparation of Sunn hemp. These samples had been prepared by a method involving the use of ammonia and sodium sulphite. One of them was found to be of better colour and rather softer than those of the earlier series, and

was valued by London merchants at the same price as high-grade Indian Sunn. It was suggested that large-scale experiments should be made to ascertain the possibility of producing such fibre in commercial quantities, and that in the first instance one or two bales should be sent to the Institute for trial sale and report.

JUTE

One of the earliest researches at the Imperial Institute was undertaken with the object of ascertaining the quality of the jute fibre obtainable from plants at different periods of growth. For this purpose a special series of samples were collected at Rahuta, a village 20 miles north of Calcutta. They represented the fibre obtained from stems cut (1) before flowering, (2) after budding, (3) when in flower, (4) when in pod, and (5) when fully matured. The results of chemical examination showed that the samples did not vary greatly from one another in composition, and thus indicated that the fibre does not undergo any sudden change at critical stages in its life-history. There was, however, considerable difference in the appearance, colour, and fineness of the samples, the earliest specimens being superior in all these respects to those gathered at later periods. In general it would appear that during growth the fibre becomes gradually less lustrous, coarser, harsher, and more brittle. This fact seems to be realised in India, as the crop is usually regarded as being in season when the flowers appear, and to be past season when in fruit, and it is considered that the later the stems are cut the coarser is the fibre.

Since the date of that investigation similar observations at the Imperial Institute have been repeatedly made with both jute and related fibres, and these confirm the view that the fibre deteriorates as the age of the plant increases.

A further series of samples forwarded from Rahuta at the same time had been specially prepared with a view to determining the result of treating jute with sodium carbonate and sodium sulphite. In each case the freshly stripped, wet fibre had been steeped in the solution (2 per cent. sodium carbonate or 2 per cent. sodium sulphite) and afterwards washed and dried. It was thought that the treatment with sulphite might remove the more easily hydrolysable constituents of

the fibre and thereby reduce the risk of fermentation in the bales. This, however, was not found to be the case. The fibre had been rendered more sensitive to the action of hydrolytic agents, and therefore had certainly not become less prone to change. Moreover, the jute had become darker in colour and distinctly more tender. The examination of the portion treated with sodium carbonate showed that in this case also no advantage had accrued. As the outcome of the work it was considered that chemical treatment of the fibre before despatch to the mills or before export could not be advocated. More recent experiments at the Imperial Institute have supported this conclusion, and shown that, as a rule, the application of chemicals to jute tends to reduce both its lustre and strength.

In reporting these results to the Government of India it was stated that the most hopeful directions for further experimental enquiry were those (1) of improving the stock by selection, and (2) of determining the most suitable time for harvesting, the object being to ensure that the fibre is cut at the best time.

Subsequently, selection experiments were carried out by the Fibre Expert to the Government of Bengal, and promising results were obtained. Samples of the fibre of some of these varieties were examined at the Imperial Institute and the results were reported in its BULLETIN (1919, **17**, 464; 1922, **20**, 30).

Reference may be made here to an investigation carried out in 1908 of the damage caused to jute by baling it in a moist condition. This damage occurs chiefly in the centre of the bale and is therefore known as "heart-damage." It is due to bacterial fermentation which attacks the cellulose of the fibre and causes decomposition to take place, rendering the jute extremely weak, and, in severe cases, almost reducing it to powder. The examination of such damaged material showed that the decayed fibre contained free acetic acid, the presence of which was doubtless due to bacterial action since Omelianski (*Centralbl. Bakt.*, II, 1902, **8**, 193) has shown that this acid among others is produced when cellulose is broken down by the action of certain bacteria.

Jute cultivation has been the subject of experiments in many parts of the Empire, including the Sudan, Rhodesia, South Africa, Fiji, Hong Kong, and various parts of West

Africa, and specimens of the fibre produced in all these countries have been received and examined at the Imperial Institute, and reports on many of them may be found in the BULLETIN. In none of these countries, however, has a permanent jute-growing industry been established. The chief difficulties which have been encountered are (1) lack of water for retting, and (2) the cost of labour, which is usually too high for the fibre to be obtainable at a price comparable with that of Indian jute.

Jute Substitutes.—There are numerous plants, particularly of the natural orders Malvaceæ and Tiliaceæ, which yield bast fibres similar to jute and capable of being spun as a substitute for it or in admixture with it. Specimens of the fibres of the following species have been submitted to examination and report at the Imperial Institute:—

Malvaceæ: *Abutilon angulatum* (= *A. intermedium*), *A. Avicennæ*, *A. Bedfordianum*, *A. periplocifolium* (= *Wissadula rostrata*), *Hibiscus Abelmoschus*, *H. cannabinus*, *H. esculentus*, *H. guineensis*, *H. heterophyllus*, *H. lunariifolius*, *H. mutabilis*, *H. quinquelobus*, *H. rostellatus*, *H. Sabdariffa*, *H. squamosus*, *H. tiliaceus*, *H. vitifolius*, *Lavatera arborea*, *L. maritima*, *Malachra capitata*, *Plagianthus betulinus*, *P. pulchellus*, *Sida carpinifolia*, *S. cordifolia*, *S. mollis*, *S. rhombifolia*, *Sphæralcea umbellata*, *Urena lobata*, *U. sinuata*.

Tiliaceæ: *Grewia occidentalis*, *Honckenya ficifolia*, *Sparmannia africana*, *Triumfetta cordifolia*, *T. pentandra*, *T. rhomboidea*.

Sterculiaceæ: *Abroma augusta*, *Helicteres Isora*, *Sterculia acerifolia*, *S. diversifolia*.

It is thus evident that in the event of a shortage of Indian jute there is an abundance of material which could be grown to replace it.

These substitutes are by no means all of equal merit, and the results of their examination have indicated that the best fibres are those of *Sida* spp., *Urena lobata* and *Malachra capitata*. From a commercial standpoint the two most important of these plants at present are *Abutilon Avicennæ* and *Hibiscus cannabinus*, which yield the fibres known in the markets of the United Kingdom as "China jute" and "Bimlipatam jute" respectively. The fibre of *Urena lobata* is grown on an industrial scale for local bag manufacture in

Brazil, Cuba, and Madagascar. *Hibiscus quinquelobus*, a plant known in Sierra Leone as " Kowe " or " Corwey," and sometimes referred to as " West African jute," yields a fibre which, if collected at the best period of growth, is comparable with Calcutta jute. If gathered from old stems, however, it is liable to be coarse and interlaced, and the same is true of many fibres of this class. A small trade in this Sierra Leone fibre was developed during the years 1904-05. A similar fibre, derived from *Hibiscus lunariifolius*, was exported from Nigeria in 1908-09, the shipments in the latter year amounting to about 337 tons.

There is yet another bast fibre of this class which deserves special mention, as a few years ago it received a good deal of publicity under the name of " Brotex." This is derived from *Lavatera arborea* (the tree mallow), a plant which occurs on the coast of many parts of Great Britain and Ireland. It is by no means a new discovery, as attention was drawn to it about 80 years ago. Notes on the subject appeared in the *Journal of the Society of Arts* (1860, **8**, 619; 1861, **9**, 540) which indicated that the plant bears an inner bark of a very fibrous character, suitable for the manufacture of ropes, mats, and other articles.

In 1930 some freshly collected specimens of the plant were kindly forwarded to the Imperial Institute from Jersey by Mr. R. L. Proudlock. It was found that on simple mechanical treatment the bark of the plant yielded long strands of white, harsh, rather coarse fibre of a somewhat woody nature. This product was not very strong and was much inferior to jute, so that judging from these experiments it appeared unlikely that it could be profitably produced on commercial lines in competition with jute and other fibres already available on the market.

Cordage Fibres

Manila Hemp.—Experiments have been made in several parts of the Empire in connection with the production of Manila hemp, the fibre of *Musa textilis*, and many samples have been received for examination and report. Among the most interesting of these were a series of graded fibres from St. Vincent, obtained from plants that officers of the Agricultural Department had found growing in the Island. They

proved to be of very promising quality, and Mr. Alfred Wigglesworth, Chairman of the Imperial Institute's Vegetable Fibres Committee, stated that the samples were among the best he had seen produced outside the Philippine Islands, and were considerably better than the lower grades from these Islands. He added that in his opinion it would be distinctly worth while to propagate the plants for the production of the fibre on a commercial scale. At a later date a few bales of the fibre were forwarded for trial sale, and these realised very satisfactory prices. Eventually, however, it was decided that the fibre could not be profitably produced in St. Vincent for export owing to the high cost involved in its preparation by hand and the inability of the Agricultural Department to find satisfactory machinery for the purpose.

While considering Manila hemp it may be of interest to recall a problem of some commercial importance which was placed before the Imperial Institute in 1921. At that time certain consignments of Manila hemp arriving in the United Kingdom were found to be very deficient in strength. Samples of the defective fibre were provided by Messrs. Wigglesworth & Co., Ltd., for examination with a view to the discovery of the cause of the inferiority. They were submitted to chemical tests and analysis, and the results indicated that the fibre had been affected by some fermentative process leading to degradation of part of the cellulose with formation of decomposition products soluble in water and an increase in the amount of matter soluble in hot dilute alkali and in acetic acid. This was supported by the fact that the weaker and more damaged the fibre the lower was the percentage of cellulose present and the greater the loss of weight on treatment with hot water, dilute alkali or acetic acid. Confirmation was obtained by exposing some of the damaged fibre to hot moist conditions in the laboratory, when it was found that the cellulose underwent further degradation and the fibre became still weaker. It therefore seemed clear that the damage that had taken place in the consignments of Manila hemp was due to degradation of the cellulose by bacterial fermentation promoted by long storage in a moist condition at a tropical temperature, and it was pointed out that in order to avoid such deterioration the utmost care should be taken in the Philippines in drying the fibre and in ensuring that it is not stored or baled in a moist state.

These conclusions were subsequently fully corroborated by investigations carried out at the Bureau of Science in Washington and by a detailed study conducted by the Philippine Bureau of Agriculture.

In addition to the Manila hemp plant there are several other species of Musa (the bananas and plantains) which bear fibrous leaf-sheaths. Samples of fibre from such plants have been received at the Imperial Institute from many different countries and submitted to examination. The most common of these plants is the ordinary fruiting banana, but its fibre is generally much weaker than Manila hemp and would be of comparatively little value for cordage manufacture.

A more promising source of fibre is a wild banana (*Musa Livingstoniana*) which is widely distributed in Kenya; it is propagated from seed and usually requires from 2 to 2½ years to reach maturity. About a quarter of a century ago attention was devoted to this plant by the Department of Agriculture, and it was found that a useful fibre could be extracted from the leaf-sheaths by a method of beating, scraping, washing, and drying. Samples of this fibre examined at the Imperial Institute were of good length, strength, and colour, and comparable with the higher grades of Manila hemp. This product has never become an article of export owing to the lack of suitable machinery for its extraction and owing to its preparation by hand being expensive and unreliable. If, however, a satisfactory machine were introduced a profitable industry could be established, as not only could the wild plants be utilised, but a permanent supply could be readily obtained by cultivation.

In 1903 samples of the fibre of two other species of Musa, viz., *M. Ensete* and *M. ulugurensis*, were received from German East Africa (now Tanganyika Territory). Both fibres were of a useful character, that of *M. Ensete* being superior to that of *M. ulugurensis*. They were regarded by commercial experts as of very promising quality and equal in value to high-grade Manila hemp.

Sisal Hemp.—Sisal hemp, the fibre obtained from the leaves of *Agave sisalana*, has been cultivated, either experimentally or commercially, in many countries of the British Empire, and samples from Cyprus, India, Malaya, Borneo, Rhodesia, Uganda, Nyasaland, Natal, Gold Coast, Sierra

Leone, Mauritius, Trinidad, Jamaica, Bahamas, British Honduras, South Australia, Fiji, and Papua have been examined at the Imperial Institute and reports furnished on their character and commercial value. Many samples have also been received from Kenya and Tanganyika where sisal production is now of great importance, and assistance in the development of the industry has been rendered by the supply of information to prospective planters regarding the localities, soil, and climate suited to the crop, and the best methods of cultivating the plants and preparing the fibre. In 1928 the Institute prepared an illustrated pamphlet on "Empire-grown Sisal," which was published by the Empire Marketing Board (*E.M.B. Publication* 10), and was widely distributed to cordage manufacturers, fibre merchants, and others with the object of directing attention to the value of sisal for cordage purposes and to the increasing supplies becoming available from East Africa.

As further illustrations of the activities of the Imperial Institute in this connection brief reference may be made to assistance rendered to the Bahamas and the Gold Coast. In the Bahamas a sisal-growing industry was established in 1888 and developed rapidly until in 1916 nearly 4,000 tons of fibre were exported. In recent years, however, the industry has languished, and in 1931 Mr. H. C. Sampson, C.I.E. ("Report on the Development of Agriculture in the Bahamas"), stated it had fallen on evil days and that the producer was then getting a price well below the cost of production, with the result that the plantations were becoming neglected. The matter was referred to the Institute's Vegetable Fibres Committee for consideration, and samples of the fibre were supplied for examination. The Committee recommended Government inspection of plantations under the control of the Agricultural Officer, the establishment of a system of grading, greater care in drying the fibre, and the provision of a central factory for cleaning, brushing, sorting, and baling it. At a later date the opinion of the Committee was requested regarding the possibility of introducing special implements or machinery for extracting the fibre, and samples prepared by a simple mechanical device were submitted. The samples proved to be of good quality and of approximately the same strength as commercial East African sisal. The Committee considered,

however, that in view of the lack of a sufficient supply of fresh water in the Islands for washing the fibre, it would be better to improve the existing methods to which the people are accustomed, involving retting in sea-water.

In 1919 the Governor of the Gold Coast approached the Imperial Institute for advice with reference to the possibility of creating a sisal-growing industry in that Colony, and in 1920 a plantation of 1,000 acres was started on the Accra plains. This was intended to serve as the nucleus of an industry which it was hoped would be taken up by the local farmers. A central factory was erected and equipped with fibre-extracting machinery to deal with leaves from the Government plantation as well as any which might be produced by farmers. Some excellent fibre was obtained, amounting in the year 1926-27 to 459 tons, and the results of its sale proved that satisfactory profits could be secured. Unfortunately, however, the native farmers could not be induced to undertake the cultivation of the crop and the enterprise was ultimately abandoned.

In the course of the sisal investigations the question arose as to whether there are any marked variations in the chemical composition of the fibre from different sources, and a detailed study was therefore made of a number of samples representative of ordinary commercial shipments. This involved the analysis of 27 samples, viz., nine from Tanganyika, four from Kenya, four from Portuguese East Africa, and ten from Mexico. The Tanganyika samples suffered the smallest loss when washed with hot water or with acetic acid and contained the largest proportion of cellulose; the Kenya samples were intermediate in these respects between those from Tanganyika and Portuguese East Africa, whilst the Mexican samples were mostly inferior to those from East Africa owing to the large amounts of soluble impurity present and the correspondingly low percentages of cellulose. There appeared, however, to be little difference in the stability of the actual fibre substance (i.e. after the removal of soluble impurity) of the samples, both East African and Mexican.

The rapid growth of sisal production in Kenya and Tanganyika rendered it desirable to obtain new outlets for the fibre, and it was hoped that it might find an extended application as a substitute for Manila hemp, one of the chief

uses of which is for the manufacture of marine cordage. There appears, however, to have been a general impression that sisal hemp is unsuitable for this purpose, it having been alleged that it is unable to withstand the action of sea-water. In 1925 the Imperial Institute therefore started an investigation with the object of determining definitely the effect of sea-water on the strength and durability of sisal in comparison with Manila hemp. For these experiments, carried out with the assistance of the Vegetable Fibres Committee, a number of ropes manufactured to the same specification and of the same circumference (in most cases 3 in.) were placed in wooden crates and these were fixed to the pier at Southend in such a position that they were completely submerged at high tide and completely exposed at low water. Care was taken to ensure that all the ropes received precisely the same treatment. Portions of the ropes were withdrawn at intervals, and, after being thoroughly washed with fresh water, were allowed to dry in the air. The breaking strains of the air-dry ropes were determined before treatment and after each period of immersion. Six series of such trials were carried out in which 16 different sisal ropes and 10 Manila ropes were tested. Similar trials were made with ropes composed of New Zealand hemp, Mauritius hemp, and Indian sunn hemp, and these are being referred to in connection with the respective fibres.

The results of the trials showed that, contrary to the common belief, there is actually but little difference in the durability of sisal and Manila hemp when exposed to the action of sea-water. In some cases the Manila ropes showed a slight advantage, whilst in other cases the advantage was rather with the sisal, but, on the whole, the differences were insufficient to be of practical importance.

During the progress of this work a series of independent trials on similar lines were carried out by the Admiralty and these confirmed the conclusion that sisal fibre can be regarded as satisfactory so far as its capacity to resist the action of sea-water is concerned. The Admiralty then arranged for small-scale trials in some of H.M. ships under service conditions. The results were so favourable that it was decided that large-scale trials should be made, and sisal cordage was accordingly issued to vessels in the Royal Dockyards and in the Fleets. The reports received from the ships were regarded

as sufficiently promising to warrant the partial adoption of sisal, and arrangements were made of its use for 50 per cent. of the service requirements for towing hawsers and heaving and hauling lines, and for its entire adoption in the manufacture of cordage for sundry other purposes.

Among other studies of sisal hemp at the Institute mention may be made of a series of experiments to ascertain the rate at which sisal and Manila ropes would develop mould or mildew under conditions similar to those of a ship's forecastle. It was found that in a moist atmosphere the sisal ropes used mildewed more readily than the Manila ropes, and evidence was obtained that in the case of sisal the mildewing was due to the presence of specific organisms on the fibre which probably originated in the country of production. After immersing the ropes for a short time in sea-water, the sisal rope no longer showed a greater tendency to become mildewed than the Manila rope, and it would therefore seem that the specific organisms on the sisal are eliminated by exposure to sea-water.

At the suggestion of the Vegetable Fibres Committee experiments were carried out to determine the effect on sisal and Manila ropes of exposure to high temperatures. The results showed that the fibres slowly suffered loss of strength under hot dry conditions, but that they regained their strength to a large extent when subsequently allowed to stand in the air under ordinary conditions of temperature and humidity. It also appeared that the sisal ropes withstood the effect of the dry heat better than the Manila.

Attention has been paid at the Imperial Institute to the possible utilisation of the waste produced in extracting sisal fibre from the leaves, the short tow obtained on hackling and brushing, and the sisal poles and stumps (or boles) left on the plantations. Some of these wastes have been found suitable for paper-making and specimens of hand-made paper have been made in the Institute's laboratories.

It has been suggested in certain quarters that the demand for sisal might be increased if the fibre could be rendered softer and more pliable, and suitable for use as a substitute for the soft hemps. Several different methods have been devised for effecting this change in the fibre, and specimens of the treated material have been examined at the Imperial

Institute. The methods depend on the partial disintegration of the strands of fibre, the chemical methods dissolving more or less of the pectinous substances by which the ultimate fibres are united to one another, and the mechanical methods tending to the destruction of the physical structure of the material. On the whole it seems questionable whether it is desirable to spoil a good fibre in the hope of rendering it applicable to purposes for which it is naturally unfitted and for which other fibres are already available.

In addition to *Agave sisalana*, the sisal hemp plant, there are many other species of Agave which yield a leaf-fibre of similar character, and the fibres of a number of these from various parts of the world have been examined at the Imperial Institute. Some of them approach true sisal hemp in quality whilst others are distinctly inferior. One species, *Agave amaniensis*, is being carefully studied at the East African Agricultural Research Station at Amani, Tanganyika. The fibre from this plant has been examined at the Imperial Institute and considerable attention has been paid to it by the Vegetable Fibres Committee. Cordage was manufactured from a bale of the fibre by a firm represented on the Committee, and various tests were carried out with it by the firm in co-operation with the Institute. Rope of a nominal girth of 3 in. was compared with a similar rope made to the same specification from No. 1 East African sisal. Although the weight per unit length of these ropes was identical, the *A. amaniensis* rope was nearly ¼ in. greater in actual girth than the sisal rope, and tensile tests at the Institute showed that its average breaking load was 11,022 lb. as compared with 9,400 lb. for the sisal rope. On making allowance for the difference in girth it would appear that ropes of the same girth would have approximately the same strength. Hence for ropes of the same girth and equal strength less *A. amaniensis* fibre than sisal would be required, and, moreover, the former rope would be rather lighter to handle. The rope manufacturers considered the fibre to be of satisfactory softness and pliability and very suitable for cordage of all sizes. A firm of twine manufacturers also reported favourably.

Mauritius Hemp.—We now turn to Mauritius hemp, the fibre derived from the leaves of *Furcræa gigantea*, a plant of the same natural order as the Agaves (Amaryllidaceæ) and

of similar habit. The fibre resembles sisal hemp in its general properties, but is usually rather finer, softer, and weaker. The plant occurs in many parts of the British Empire, and samples of the fibre from Mauritius, Uganda, Nyasaland, Rhodesia, Natal, India, and South Australia have been examined at the Imperial Institute. In connection with the trials of Empire fibres for marine cordage, the Government of Mauritius requested that tests should be carried out with ropes made of Mauritius hemp, and consignments of three grades of the fibre were supplied for the purpose. Ropes of 3 in. girth were made according to the usual specification employed in these trials. The initial strength of the ropes was low in comparison with that of sisal and Manila ropes, but the results of immersion tests in sea-water showed that the rate of deterioration was practically the same as that of the latter ropes. Mauritius hemp ropes would, however, not be acceptable in the United Kingdom as marine cordage, since their initial strength is too low to satisfy the official standards.

New Zealand Hemp.—Another cordage fibre to which the activities of the Imperial Institute have been directed is that known as New Zealand hemp or phormium, which is derived from the leaves of *Phormium tenax*, a plant of the Liliaceæ. Many samples of the fibre have been examined, including some submitted by inventors of special processes of preparation. These latter were dealt with at the request of the High Commissioner for New Zealand in London, and reports were furnished as to their quality in comparison with ordinary commercial grades of the fibre and as to the probable value of the processes of preparation. In 1928 the Department of Scientific and Industrial Research, New Zealand, asked that information might be obtained from representative firms regarding the suitability of phormium fibre, as then exported, for the uses to which it is applied by British manufacturers. An enquiry was therefore made and a memorandum was furnished in which special attention was called to the observations of certain firms as to quality, grading, and cleaning, and suggestions were made for effecting desirable improvements.

The investigation into the suitability of Empire fibres for marine cordage in place of Manila hemp was extended to New Zealand hemp at the request of the High Commissioner.

The results of tests on nine 3 in. ropes made from this fibre showed that their durability when exposed to the action of sea-water was very similar to that of Manila ropes. Subsequently the Admiralty carried out small-scale trials under service conditions, and the results obtained were so promising that trials on a larger scale were made in the Royal Dockyards and in H.M. ships on different stations. The breaking strains of the cordage of all sizes immediately after manufacture equalled (and in most cases exceeded) the standard of the Government departmental specification for Manila cordage. The reports received both from ships and shore services were mostly very favourable, and the Admiralty therefore decided that (as in the case of sisal) New Zealand hemp may be used in the Royal Navy for specified purposes.

In 1929 a proposal was made in New Zealand for the installation of a factory for the production of artificial silk from phormium fibre. The Department of Scientific and Industrial Research of the Dominion therefore asked that an investigation might be made at the Imperial Institute to ascertain the possibilities of such an enterprise. In compliance with this request experiments were carried out which showed that the fibre furnished 70 per cent. of a bleached pulp of a composition quite suitable for artificial silk manufacture. It was pointed out that a manufacturing trial would be necessary before a definite conclusion could be reached, and that, in any case, it seemed unlikely that the employment of the fibre for this purpose would be remunerative.

In the course of extracting New Zealand hemp from the leaves, very large quantities of waste pulp are produced. Samples of this waste material were forwarded to the Imperial Institute from St. Helena in 1918, and further samples from New Zealand in the following year, with the request that an investigation should be made with a view to determining whether any commercial use could be made of it, either as a paper-making material, a manure, or a source of potash. Experiments were accordingly carried out, and it was found that the pulp would be of very little value for use in paper-making. The results of chemical analysis showed, however, that the waste contained comparatively large amounts of nitrogen, potash, and phosphates, and that it would be of use as a manure, for which purpose either the original material

or the ash obtained on burning it could be employed. The ash might also be utilised as a source of potash salts.

In St. Helena phormium has been planted over large areas, and during the years 1876-1880 there was a small export trade in the fibre. The industry subsequently lapsed, but in 1906 an endeavour was made to resuscitate it. Samples of the fibre produced in the Island were examined at the Imperial Institute in comparison with that from New Zealand and suggestions were made for improving the quality of the product. Particulars were also supplied as to the trade in the fibre, methods of preparation, makers of suitable machinery, and related matters. For some years the fibre has formed the principal export of the Colony. A few years ago, in order to give additional employment in the Island, a cordage works was established, equipped with plant capable of supplying about 250-300 tons annually. Consignments amounting to 5 or 6 tons of cord, twine, and 1 in. rope were forwarded to the Imperial Institute for trial sale, but, as some difficulty was experienced in disposing of it, the St. Helena authorities came to the conclusion that it would be more profitable to continue to export fibre rather than cordage.

The Imperial Institute has also given assistance and advice in connection with attempts to produce New Zealand hemp in parts of the United Kingdom. Experiments with the plant have been made in the south-west of Scotland; several acres were planted, extracting machinery was introduced, and in 1913 a crop of fibre was produced, a sample of which was examined at the Imperial Institute and found to be of satisfactory quality. These experiments, however, did not lead to the establishment of a permanent industry.

About eight years ago an effort was made to grow phormium in South Devon and Cornwall. Some 300 acres were planted near Kingsbridge and satisfactory growth ensued. Advice was given by the Imperial Institute, and samples of the fibre examined proved to be of promising character. Unfortunately, however, the enterprise was not continued in a satisfactory manner, and the plantations became neglected.

Some of the plants grown in Cornwall were supplied to the Government of the Isle of Man, where it is hoped to create a phormium industry as part of the scheme for absorbing the unemployed. The Empire Marketing Board arranged for

representatives of Kew Gardens, the Imperial Institute, and the New Zealand Department of Scientific and Industrial Research to visit the Island and report on the possibilities, and, as a result of their report, planting operations were commenced in 1932. The industry has not yet reached the stage of production.

Bowstring Hemps.—Another class of fibres suitable for cordage manufacture comprises those known as "bowstring hemps" obtained from the leaves of various species of *Sansevieria* (natural order Liliaceæ). These plants are abundant in tropical Africa, and the fibres of several species have been examined at the Imperial Institute, including those of *S. guineensis*, *S. Ehrenbergii*, *S. cylindrica*, *S. fasciata*, *S. sulcata*, *S. Stuckyi*, and *S. volkensis*. The quality of the fibres of the different species varies greatly, that of *S. guineensis* consisting of fine, lustrous, strong strands of even diameter, whilst the strands of *S. Ehrenbergii* show a very marked variation in diameter, those from the interior of the leaf being extremely fine whilst those from the exterior are very coarse. In 1905 the extraction of fibre from plants (chiefly *S. Ehrenbergii*) growing wild over extensive areas in Kenya was undertaken on a commercial scale, a factory being erected and equipped with machinery similar to that used for extracting sisal hemp. The fibre was, however, of rather unsatisfactory quality, and after a few years its production declined, attention being transferred to the cultivation of sisal hemp. Samples of *S. guineensis* from West Africa and other countries have been found at the Imperial Institute to be of excellent quality, but in order to create a profitable industry in this fibre special machinery would be required as the leaves are thin and flat and the fibre is therefore less easily extracted than in the case of thick leaves, such as those of *S. Ehrenbergii*.

MISCELLANEOUS

There are a number of other fibres to which attention has been devoted at the Imperial Institute and which ought to be mentioned in this retrospect.

Ramie.—The question of ramie (the fibre of *Boehmeria nivea*, a plant of the Urticaceæ or nettle family) has been raised over and over again at short intervals. Samples of the product from many parts of the Empire have been submitted for

examination, and numerous specimens of fibre prepared by different methods (generally supposed by their inventors to be new and superior to all the methods devised previously) have been forwarded for report. In all cases it has been necessary to explain that ramie spinners are not disposed to purchase supplies except in the form of hand-cleaned China grass, which is prepared in China by a tedious process that can only be employed where very cheap labour is available, and that profitable production in other countries seems to be impracticable. Moreover, new processes of preparing the fibre are not needed, as spinners degum the product by chemical methods developed in their own factories and will not readily change to any other system. The Imperial Institute has therefore found it necessary to advise planters overseas not to grow ramie unless they are able to assure themselves in advance of a remunerative market for their crops.

Fibres of Asclepias spp. (the " Milkweeds ").—Investigation of the fibres obtainable from the bast of stems of species of Asclepias has shown that it is usually difficult to obtain them in strands of good and even length as they tend to break down very readily into the ultimate fibres of which they are composed. This property, however, enables the product to be easily " cottonised " (reduced to its ultimate fibres), and attention has been given to the possibility of spinning such material, especially in admixture with cotton.

In 1928 statements appeared widely in the press regarding a mysterious fibre plant which was alleged to have been discovered in British Guiana and subsequently planted in Essex and Sussex. The fibre was termed " artificial cotton," and a company was formed to develop its production. No commercial supplies became available, however, and after a year or two the company ceased to exist. The plant in question was a species of *Asclepias*, probably *A. incarnata*, which grows over extensive areas in North America and received consideration in the United States as a source of fibre as long ago as 1890.

In 1931 samples of products derived from *A. incarnata* plants grown in England were examined at the Imperial Institute. It was found that the bast of the stems was very easily broken down into the ultimate fibres which are highly lustrous and of fair strength. These fibres have a length

ranging from 0·7 to 2·3 in. with an average of about 1·2 in., and a diameter of 0·0005-0·0014 in. with an average of about 0·0008 in. They are thus of about the same average length and diameter as cotton fibres, but their dimensions extend over a wider range. As compared with cotton, the greater unevenness in the length of these fibres and the absence of the natural twist might cause trouble in spinning them with machinery designed for cotton, but there seems a possibility that soft fabrics of useful quality might be economically made from such ultimate fibres if the ordinary cotton machinery could be successfully adapted to spin them without much wastage. It might perhaps prove satisfactory to spin the material in conjunction with cotton.

The examination at the Imperial Institute of the bast fibres of other Asclepiadaceous plants, viz., *Asclepias semilunata* from Uganda, *A. fruticosa* from South Africa, *Calotropis procera* from India and from the Sudan, and *C. gigantea* from India, has shown that these are all of a similar character to that of *A. incarnata*.

Pineapple Fibre and Allied Products.—On many occasions the attention of the Imperial Institute has been directed to the fibres obtainable from the leaves of the pineapple and other plants of the same natural order, Bromeliaceæ. Samples of pineapple fibre have been received from India, Gold Coast, Rhodesia, and other parts of the Empire. Their examination has shown that the product is a fine, soft, strong fibre which is white and lustrous and would probably serve as a substitute for flax. The fibre is used in the Philippines and Formosa for making fine silky fabrics but is not exported to Europe. Its preparation is carried out by hand by a tedious operation which is only possible in countries provided with very cheap labour.

Another fibre of this class is that derived from the leaves of the Caroa or Carua plant (*Neoglaziovia variegata*), which is indigenous to Eastern Brazil. Samples of this fibre from Brazil were first examined at the Imperial Institute in 1903. The product is of excellent quality and similar in character and composition to pineapple fibre, but the difficulty of extracting it has prevented its commercial production for export. Other samples of this or a closely related fibre have been received from British Guiana and the West Indies under the name of Crowa and found to possess the same properties.

In British Honduras a species of *Bromelia*, known as "silk-grass," yields an excellent fibre resembling those already mentioned, but here again the extraction of the fibre from the leaves by the native hand-process is extremely laborious. This was shown by a small experiment carried out some years ago by forest officers of the Colony in which the production of 2 oz. of the fibre cost no less than 7*s*.

The British Honduras plant is apparently identical with a fibre plant called "pita" which grows wild over extensive areas in Colombia, South America, and has been described by Mr. M. T. Dawe. This plant has been studied at the Royal Botanic Gardens, Kew, and given the name *Bromelia Magdalenæ*, C. H. Wright. Several samples of fibre from the leaves of the plant have been examined at the Imperial Institute and found to be long, strong, fine, lustrous, of a pale straw tint, and well adapted for the manufacture of fine twines. There is no doubt that this fibre, like others of the same family, would find a ready market, but hitherto it does not appear to have been exported in commercial quantities. In 1919 a scheme was launched for the cultivation of the plant (under the name of "Arghan") in British territory, and a company was incorporated under the style of the Arghan Company, Limited. The company procured a supply of plants and transported them to the Federated Malay States for cultivation, but no tangible results were obtained, and the company subsequently ceased operations and went into liquidation.

As already mentioned, there has hitherto been a serious obstacle to the exportation of pita and similar fibres owing to the fact that they are very difficult to extract from the leaves on a commercial scale. Statements have been made from time to time that machines have been devised capable of extracting the fibre sufficiently cheaply for it to be placed on the market, but experience alone can prove whether any machine hitherto invented will, when working on commercial lines, actually give a satisfactory yield of fibre of good quality.

Palm-leaf Fibres.—The leaflets of the oil-palm (*Elæis guineensis*) yield a fine fibre which is used by the natives of West Africa for making fishing lines and fine cordage. The examination of samples of this product at the Imperial Institute has shown that it is a pale yellowish-green fibre of

quite remarkable strength and excellent quality. Small quantities of the fibre have appeared from time to time on the market, but the cost of production by hand is so great as to make it impossible to prepare it at any but a prohibitive price, even with the advantage of native labour. If, however, a cheap method of separating the fibre from the leaves could be devised and a constant supply became available for export, it would find a ready market.

In 1894 a small sample of fibre extracted from the leaf-stalks of the "groo-groo" palm (*Acrocomia sclerocarpa*) was received from St. Vincent. This fibre is used by the natives of the Island for making fishing-lines. It consisted of fine filaments of very uniform diameter which were rather harsh and wanting in lustre, but it was considered that by careful manipulation it could be prepared in a better condition and would then be suitable for spinning into fine counts of yarn.

A palm fibre of a particularly interesting character was received in 1905 through the Foreign Office from the British Legation in Paraguay. This so-called "vegetable wool" was said to have been prepared from the leaves of a palm growing abundantly in that country and to be obtainable in large quantities. As in the case of the palm fibres already mentioned, however, the cost of extraction by hand would be too great to enable it to be profitably exported. This product was a fine cream-coloured fibre consisting of filaments of about the same diameter as those of the oil-palm fibre (0·002-0·005 in.) but not so strong. It was remarkably harsh and rough to the touch, and microscopical examination showed that this property was due to the presence of minute external excrescences. It was considered by experts that the product would probably be useful for the manufacture of twine or coarse thread or as a material for matting and carpets. Further samples of a palm fibre were received from South America in 1926, and these closely resembled the Paraguay material in character but were of greater strength. There seems little doubt that these products consisted of the fibre of the palm known as *Bactris setosa*, small quantities of which are exported from Brazil under the name of "Tucum" fibre.

In concluding this survey of the work accomplished by the Imperial Institute in connection with vegetable textile

fibres, I am conscious of the many omissions I have been compelled to make. I have made no allusion to a number of the Institute's investigations, and have failed even to mention the names of many of the fibres examined. The latter, for the most part, are quite unknown to commerce. I can, in fact, sympathise with the eloquent exaggeration with which the author of the Fourth Gospel closed his work—" there are also many other things . . . the which, if they should be written every one, I suppose that even the world itself could not contain the books that should be written." Nevertheless, I trust that the examples I have been able to cite may show that in respect of fibre investigation the Imperial Institute has served a useful purpose and has established a permanent record, harmonising in some small degree with the spirit enshrined by Tennyson in his ode on the Jubilee of Queen Victoria :—

> " Raise a stately memorial,
> Make it regally gorgeous,
> Some Imperial Institute,
> Rich in symbol, in ornament,
> Which may speak to the centuries
> All the centuries after us."

THE SOURCES, PRODUCTION AND USES OF SELENIUM AND TELLURIUM

ALTHOUGH the possibility of obtaining selenium and tellurium from the waste products of certain large-scale metallurgical processes has been realised for many years, the lack of any considerable demand has hitherto hindered commercial production. In the last few years, however, as the result of intensive research into possible uses, some demand has arisen and these elements are now produced on a commercial scale. A large potential source of supply exists in the by-products from electrolytic copper refining and an increased demand could easily be met.

Selenium and tellurium compounds are widely distributed in nature, but they are never very abundant. Some deposits of native sulphur contain small quantities of these elements, as do many deposits of iron pyrites and sulphide minerals of copper or lead. A number of minerals contain selenium

or tellurium as major constituents, but none of them occur in sufficient quantity to warrant their treatment for the extraction of these elements. The silver and silver-gold tellurides have long been known as important sources of the precious metals. The ores of Cripple Creek, Colorado, and of the Great Boulder Reef of Australia are of this type, but apparently tellurium is not recovered from this source. Commercial selenium and tellurium are obtained mainly from iron and copper pyrites.

PROPERTIES

It is unnecessary here to enter into a consideration of all the chemical and physical properties of selenium and tellurium and their compounds, but it may be useful to consider a few of those which are of special interest from the point of view of extraction and uses.

Selenium.—The properties of selenium and its compounds are similar but intermediate in character between those of sulphur and tellurium. The element itself may exist in four modifications, (1) amorphous, including powdery red and vitreous black forms, (2) and (3) the red unstable alpha and beta monoclinic crystalline forms, and (4) the grey hexagonal crystalline metallic form. On saturating a solution of selenious acid with sulphur dioxide gas, a brick-red precipitate of red amorphous selenium is obtained. If this is melted by heating to 217° C. and cast with rapid chilling, the vitreous form is produced, which is a black, brittle, glassy mass with no true melting point. On heating vitreous selenium for several hours at 100° C. it is transformed into the metallic form, which consists of steel-grey hexagonal crystals, having a specific gravity of 4·8 and a melting point of 217° C. This form, which is the only one of metallurgical interest, possesses a remarkable property in that its electrical conductivity varies according to the intensity of the light falling upon it. The other forms are non-conductors of electricity.

The ease with which selenium combines with certain metals is a disadvantage in the preparation of its alloys.

Tellurium.—In its chemical properties tellurium resembles selenium and sulphur, forming in most cases similar series of compounds, although they are less stable. In physical properties, however, it more closely resembles antimony. It is a silver-white, lustrous, brittle, metallic-looking substance which

crystallises in hexagonal rhombohedra isomorphous with sulphur and selenium. It has a specific gravity of about 6·25, melts at 452° C. and is appreciably volatile at a red heat. It is a poor conductor of heat and electricity and, unlike selenium, its electrical conductivity is independent of the degree of illumination.

METHODS OF EXTRACTION

The selenium and tellurium of commerce are obtained as by-products. The first source of selenium to be developed commercially was the mud deposited in the lead chambers of sulphuric acid plants, where it is derived from the burning of pyrites. The Scandinavian pyrites and the copper ores of Mansfeld, Germany, are noted for the presence of selenium, which was originally obtained from these materials. Some selenium is still extracted from the acid chamber mud, from the crude sulphuric acid itself, or during preliminary purification of the sulphurous gases used in the contact process. In roasting pyrites the selenium is oxidised to selenium dioxide, which is then reduced by the sulphur dioxide in the lead chambers to finely divided selenium, which is deposited as a red sludge. The method of extraction of the selenium from the lead chamber mud is described in some detail by G. M. Dyson (*Chem. Age, Lond.*, 1928, **18**, No. 453, 17) and is briefly as follows: The selenium was at first recovered from this sludge by a dry roasting process, but losses were considerable, and the final product contained about 0·5 per cent. of lead, which rendered it unsuitable for use in photo-electric cells. This method was therefore superseded by a wet purification process for oxidising selenium. Three methods of oxidation have been used: (1) by potassium permanganate; (2) by sodium or potassium chlorate; and (3) by oleum containing 20 per cent. of sulphur trioxide. In all these methods selenium is dissolved while lead and other impurities remain insoluble and are removed. Selenium is then precipitated by sulphur dioxide and finally purified by distillation in a still constructed of cast iron containing 5 to 6 per cent. of silicon. The final product, which is usually 99·5 per cent. pure, contains traces of iron and sulphur but is quite free from tellurium. It is claimed that of these three processes the oleum method is the cheapest and the most suitable.

The bulk of the selenium and tellurium of commerce, however, is now obtained as a by-product in the electrolytic refining of copper. In the usual pyrometallurgical process for treating copper ores, selenium and tellurium are concentrated in the blister copper, and the processes for their extraction are complicated, involving the simultaneous production of pure copper, selenium, tellurium, gold and silver. Descriptions of processes for the electrolytic purification of copper and the treatment of the anode slimes are given in *Trans. Amer. Inst. Min. Metall. Engrs.*, 1933, **106**, 344-427. Blister copper produced by different smelters varies greatly in composition; that from Arizona is relatively high in selenium (0·15 per cent.), while Montana copper is low in selenium with 0·10 per cent. tellurium, and the eastern Canadian coppers contain as much as 0·26 per cent. of total selenium and tellurium (W. E. Milligan, *Modern Uses of Non-ferrous Metals*, ed. by C. H. Mathewson, A.I.M.E. Series, 1935, New York, p. 312). The variability of this material is shown by analyses of commercial blister coppers quoted by C. S. Harloff and H. F. Johnson (*Trans. Amer. Inst. Min. Metall. Engrs.*, 1933, **106**, 403), in which the total selenium and tellurium content ranges from 0·0002 per cent. in the case of Katanga blister, to 0·20 per cent. for that of the Noranda smelter.

Selenium and tellurium are not present in blister copper in the free state but as selenides and tellurides of copper, gold and silver. These compounds being unattacked in the electrolytic refining process are left in the anode slime, processes for treating which vary considerably according to the material treated. Some slimes from the refining of eastern Canadian copper contain about 24 per cent. of selenium and nearly 4 per cent. of tellurium, but these are exceptionally rich, and slimes containing as little as five or six per cent. of either selenium or tellurium are common. On the average the selenium content considerably exceeds that of tellurium. The anode slimes contain small amounts of copper, and in order to recover this they are roasted and then leached with dilute acid. Some selenium and tellurium dissolve with the copper and the solution is purified by boiling with metallic copper, when a slime containing copper selenide and telluride is formed, the purified solution being returned to the electrolytic cells. This second slime is returned to the residue from leaching, which is then treated to recover the gold and silver by melting

in the Doré furnace, where the major portion of the selenium is volatilised and subsequently collected in the flue dust and in the Cottrell precipitators. The dusts are roasted at a low temperature when selenium dioxide sublimes and is collected as impure crystals known as " selenium whiskers." These are dissolved in water, the solution is filtered, and red amorphous selenium precipitated by sulphur dioxide in the presence of hydrochloric or sulphuric acid.

Most of the tellurium and some selenium which remain in the Doré furnace charge are removed by fluxing with soda ash or caustic soda and sodium nitrate, leaching with water and neutralising with sulphuric acid. Tellurium is precipitated as tellurium dioxide, which is collected, washed, dried, and either sold as such, or reduced to metal by heating with powdered coal or charcoal in large clay-lined crucibles or retorts. The metallic cakes contain from 98 to 99 per cent. tellurium with selenium as the chief impurity. The selenium remaining in solution is recovered and mixed with that obtained from the flue dust. It is converted to the black modification and either sold in this form (99·5 per cent. pure) or fused in iron pots and cast into sticks of the vitreous variety.

Some tellurium is obtained as a by-product in the refining of the platinum metals extracted from nickel ores, and it has even been recovered from the Cottrell precipitator dust at a superphosphate plant in Odessa.

In the United States there have been enquiries for additional supplies of residues and ores containing tellurium, but there is no reason to believe that the ordinary sources of the metal are proving inadequate (*U.S. Bur. Min. Minerals Yearbook*, 1936, p. 537).

Selenium is generally sold as an amorphous powder, approximately 99·5 per cent. pure, varying in fineness according to the use to which it is to be put, but cakes and sticks can also be obtained. Sodium selenite, selenious acid and selenium dioxide are also commercial products. Tellurium is usually marketed as slabs and sticks of 99 per cent. purity; both the powdered metal and the dioxide are also obtainable.

USES

Selenium.—At present, the chief use for selenium is in the glass and pottery industries. In glass-making it is used both

for decolorising and for producing a variety of colours. The first of these uses was developed during the war when the supply of manganese dioxide was reduced and selenium was found to be a suitable substitute in counteracting the green colour caused by iron. Cobalt oxide is usually added as well, and a typical mixture is $\frac{1}{2}$ oz. of selenium, and $\frac{1}{12}$ to $\frac{1}{16}$ oz. of cobalt oxide to 1,000 lb. of sand. Under certain conditions, notably with a soda-lime or potash-soda glass under oxidising conditions, by the use of selenium a pink glass can be produced, and if uranium is also added an orange colour results. A deep ruby glass suitable for signal lights is produced by the addition of 0·25 per cent. or more of selenium, together with some cadmium sulphide. Many difficulties were at first encountered, but owing to the demand for this type of glass, considerable research has been carried out and the exact conditions for producing this colour have now been determined. A brilliant amber glass, suitable for high-class table ware, is obtained by adding selenium and borax to lead glass under oxidising conditions, and a similar amber glass, useful in the construction of fog-penetrating and anti-dazzle motor headlamps, has also been developed.

Selenites of either sodium or barium are now being used in glassmaking instead of selenium, as the volatilisation loss, which was considerable with the latter, is thereby reduced.

A number of red pottery glazes are used which contain selenium together with cadmium sulphide, and a complete range of enamels from red to yellow can be obtained by mixing selenium with varying proportions of cadmium yellow. (L. Stückert, *Glashütte*, 1935, **65**, 611.)

The well-known application of selenium in the construction of photo-electric cells depends upon the fact that the electrical resistance of the metal varies proportionally with the intensity of the light falling upon it.

Early experiments in the production of sound films and in television were conducted with the aid of selenium cells, but for such purposes they were found to have undesirable characteristics which caused distorted reproduction, and have been partly replaced by other types. Improved selenium cells, however, have now been introduced but, owing to the high electrical resistance of selenium, only very thin films of the element can be employed in these cells, and the total amount

consumed in this way is not, at present, of any great commercial importance.

The photovoltaic or selenide cell, of which the Weston Photronic is a well-known example, is another form of cell in which selenium is employed. This type consists of a metal plate, usually of iron, coated with selenium, which presumably forms a compound and upon which rests a film of silver. This cell does not require an impressed voltage and in a closed circuit develops a current when light falls on the metal-selenide boundary, the current under certain conditions being directly proportional to the intensity of the light. Many other metallic selenides have been proposed for use in this way. Cells of this type are being widely used in the construction of smoke detectors, door openers, counting devices, and photographic exposure meters. Again, the total amount of selenium consumed is relatively small, but the recent successful use of cells of this type as rectifiers for alternating current in electroplating plants should increase the demand. In the past, such cells have only been used with small currents, but they are now being built to deal with 40 amps. at 440 volts.

The similarity in the properties of selenium and sulphur has prompted much research into the effects of the entire or partial substitution of selenium for sulphur in vulcanising rubber. Owing to the much higher cost of selenium, there appears to be little prospect of any considerable amount being used unless the advantages conferred by its use are very marked. There is some difference of opinion in the rubber industry regarding its applicability, but vulcanising compounds containing selenium, for use with sulphur, are being sold. Selenium without sulphur is incapable of producing a hard rubber, but in the case of soft rubber the addition of selenium has been stated to shorten the time of cure, to increase the tensile strength of the product, to improve its ageing quality, and to increase its resistance to abrasion. Rubber so treated is of use in the manufacture of rubber soles and heels, tyre treads, and for other purposes where abrasion resistance is important. More than 100,000 lb. of selenium are stated to have been used in the rubber industry of the United States in 1929. Later figures are not available, but if a demand for rubber which contains selenium were to develop to any considerable extent this should provide an important outlet.

Selenium has been used as a flame-proof covering for electrical cables and switchboards. The wires constituting the cables can be coated, or the cotton and rubber covering impregnated, with selenium. Such a cable will not continue to burn when removed from a flame and will not catch fire as a result of a short circuit.

The possibility of adding selenium to various stainless steels has been investigated and encouraging results have been obtained. Owing to high volatilisation losses when the element itself is used, the ferro-alloy (containing 52 per cent. of selenium) is added instead, the resulting steel usually containing about 0·25 per cent. of selenium.

Selenium has also been used in the manufacture of free-cutting brass and other copper alloys.

A number of pigments containing selenium have been developed, some of which might become important. The most interesting of these is the series of cadmium reds, containing cadmium sulphide and selenium. In Germany it has recently been decided to change the colour of the equipment of the Reichspost from yellow to red, cadmium red being specified for this purpose.

A protective layer of selenium may be applied to magnesium alloys used for aircraft construction. The parts are immersed for a few minutes in a 10 per cent. solution of selenious acid containing a little sodium chloride, or the solution may be swabbed on to the surface. The resultant film of selenium is very resistant to the corrosive action of sea-water spray and forms a satisfactory base for certain types of paint.

A number of minor applications of selenium have been suggested. The use of selenium dioxide as an oxidising and as a condensing agent in synthetic organic chemistry is well known, and a few such reactions which are of commercial importance have been patented (B. Pat. 354,798 and B. Pat. 367,462). Dyestuffs and photographic sensitising dyes have been prepared which contain selenium, and it has been used in a photographic toning process, while its compounds have been recommended for use as fungicides and insecticides.

Selenium oxychloride, a heavy, nearly colourless liquid, easily transportable in special containers, is worth mentioning on account of its remarkable solvent properties. It will

dissolve many materials, such as bakelite, previously regarded as insoluble.

Tellurium.—At present, tellurium is of less commercial importance than selenium, and it is fortunate that on the average it occurs less abundantly in electrolytic residues. Supplies can be made available if uses can be found, and there are a few interesting possibilities which might lead to a considerable demand. At present the production of hard lead probably provides the chief outlet. Tellurium-lead alloys were first developed in this country and have now been introduced into the United States. Although the tellurium content is small (from 0·02 to 0·085 per cent.) the alloy toughens under strain instead of progressively yielding like ordinary lead. This is a very desirable quality, for lead piping and electric cable sheathings which are now being made with this alloy are actually strengthened by the strains produced by frost, vibration, hammering and bending. The alloy is more resistant to corrosion than ordinary lead and its use lessens the danger of poisoning resulting from the use of lead water supply pipes; while it also appears to have greater resistance to sulphuric acid than the usual brands of chemical lead.

A number of possible metallurgical uses for tellurium have been suggested, but, owing to the fact that metallic tellurides which tend to segregate are readily formed, there is little possibility of producing useful alloys containing any considerable amount of tellurium, although a copper-lead alloy containing 1 to 7 per cent. of tellurium has been used for facing bearings (U.S. Pat. 2,033,321). Small amounts appear to have a beneficial effect in some alloys. The use of tellurium as a scavenger during the casting of aluminium has been patented (B. Pat. 234,547), but Sisco and Whitmore (*Industr. Eng. Chem. Industr. Ed.*, 1924, **16**, 839) who made a detailed investigation of the properties of the aluminium-copper-tellurium alloys, reported that the addition of tellurium has no practical value and may have a harmful effect on some properties of the alloy.

The use of tellurium in the rubber industry has been investigated, and the effect has been found to be similar to that obtained with selenium, but in certain cases tellurium is to be preferred. It is not so strong an accelerator of vul-

canisation as selenium but is more useful in the manufacture of thick, hard, rubber articles and of low-sulphur latex compounds; owing to its high specific gravity a specially fine powder has to be employed in the latter case. The General Electric Co. have put on the market a mining cable with an all-rubber jacket compounded with tellurium. It is possible that these applications may lead to an increased consumption of tellurium in the rubber industry.

At ordinary and low temperatures, tellurium possesses a high negative coefficient of electrical resistance, and it has been used as a resistance metal for electrically-operated refrigerators. Thermocouples for use at relatively low temperatures have been constructed with tellurium elements. It has been suggested that pure tellurium in combination with platinum be used for temperatures up to 100° C. and for those above 100° C. up to 300° C., tellurium containing one per cent. of antimony. A tellurium-bismuth vacuum-radiation thermocouple has been constructed having a sensitivity three times that obtained with the bismuth alloys previously used.

In the Tainton electrolytic zinc-purification process, cobalt is precipitated from the solution at one stage by zinc dust, and it has been found that satisfactory precipitation is obtained only if small quantities of finely divided tellurium are present in the solution. A considerable amount of tellurium has been purchased for use in this way, but crude slimes containing tellurium appear to work just as well. A solution of tellurium dioxide in hydrochloric acid is used as a dip for silverware where a dark finish is required (U.S. Pat. 1,308,092).

Tellurium coatings on magnesium alloys can be obtained, but they are inferior in quality to selenium coatings, and more expensive to produce, the dipping bath being unstable and difficult to prepare.

Blue and brown glasses and glazes containing tellurium have been made. Photographic toning baths containing tellurium have also been used.

When anti-knock compounds for addition to petrol were being developed, diethyl telluride was found to give satisfactory results with certain engines, but it was soon replaced by tetraethyl lead owing to the impossibility of obtaining large supplies of cheap tellurium. Before the introduction of cheap radio valves, tellurium was used in the manufacture of crystal

detectors, but although some 1,000 lb. of tellurium were used for this purpose in 1922, this market has ceased to be of any importance.

The finely divided metal and a number of its organic derivatives possess powerful bactericidal properties and have been successfully employed in medicine.

Tellurium has been electrodeposited from various solutions containing sulphuric and hydrofluoric acids or sulphuric and hydrochloric acids. Although bright deposits are obtained which do not tarnish readily, there is little hope of their being used for protective purposes as they are very brittle, but the electrolytic refining of crude tellurium is a possibility.

Other possible minor uses of selenium and tellurium have been suggested, but sufficient has been mentioned to show the chief directions in which development has taken place.

Production

Statistics for the production and consumption of selenium and tellurium are difficult to obtain; only in the case of Canada and the United States are reliable figures available.

Canada.—The Dominion is an important producer. Selenium was first obtained in 1931 by the Ontario Refining Co., Ltd., at Copper Cliff, Ontario. The Canadian Copper Refineries Ltd., began production in November 1934 from residues which had accumulated at Montreal East, Quebec. Most of the production is exported, no imports being recorded.

At the above-mentioned refineries production of tellurium was started in 1934, and most of the output is exported to the United Kingdom. Recent production figures are tabulated below:—

Canada—Production of Selenium and Tellurium

	Selenium.		Tellurium.	
	Quantity. *lb.*	Value. $	Quantity. *lb.*	Value. $
1933 . .	48,221	70,345	—	—
1934 . .	104,924	171,311	5,130	25,599
1935 . .	366,425	703,736	16,425	32,850

United States.—Selenium has been produced in the United States for some years. The production diminished in 1935, but the amount imported (mainly from Canada) increased enormously. Formerly, much of the domestic production was exported, but it now appears to be mostly disposed of intern-.

ally. Three companies were producing tellurium in 1935; exports were made to Europe, and enquiries were received from Germany for additional supplies of ores or metallurgical residues. Supplies of tellurium for the British market, mainly for use in hardening lead, were formerly obtained from Germany, but are now imported from Canada and the United States, and may amount to over 1,000 lb. a month.

The available figures are tabulated below :—

United States—Sales of Selenium and Tellurium (Domestic Produce)

	Selenium. lb.	Tellurium. lb.
1931	292,234	—
1932	244,123	1,567
1933	331,963	11,980
1934	319,838	21,027
1935	232,831	22,610

United States—Imports of Selenium and its Salts

	Quantity. lb.	Value. $
1931	2,189	2,777
1932	1,914	2,240
1933	1,855	2,402
1934	17,719	24,591
1935	179,331	322,332

Other Countries.—The German Mansfeld copper concern discontinued selenium production about ten years ago, and since then little or none has been produced in Germany. Supplies were formerly obtained from the United States, but about 60 metric tons are now imported annually from Sweden, where production capacity has been increased by the enlargement of the by-product plant at Boliden. A small quantity of selenium is recovered from copper refineries in Japan.

NOTES

Obituary. Mr. Thomas Crook.—The many friends which he made, both at home and overseas, in the course of his work for the development of the Empire's mineral resources, will learn with deep regret of the death on January 6 last, in his 61st year, of Mr. Thomas Crook, O.B.E., A.R.C.Sc.I., B.Sc., M.Inst.M.M., Principal of the Mineral Resources Department of the Imperial Institute.

Mr. Crook, who was a native of Burnley, Lancashire, received his early scientific training at the Royal College of Science, Dublin, and was awarded the associateship in 1901.

He then accepted a post on the teaching staff of the College, where he carried out research work and acted as assistant to Grenville A. J. Cole, the Professor of Geology and Mineralogy. He commenced his career at the Imperial Institute in 1905, and was intimately associated with the valuable laboratory work done in connection with the Mineral Surveys of Nigeria, Nyasaland, the Gold Coast, Ceylon, East Africa, etc., which were at that time being carried out under the auspices of the Imperial Institute. In this connection he was largely responsible for working out improved methods of technique in the separation and examination of mineral grains. For this and other published research work he received, in 1918, an award from the Murchison Fund of the Geological Society.

In August 1919, Mr. Crook left the Institute on his appointment as Chief Officer of the Intelligence and Publications Section of the newly formed Imperial Mineral Resources Bureau, where he was responsible for the production of the well-known series of publications on economic minerals, which were issued as Reports on the Mineral Industry of the British Empire and Foreign Countries, and also for the annual Statistical Summary. In 1926, the Imperial Mineral Resources Bureau was amalgamated with the mineral section of the Imperial Institute and Mr. Crook was appointed Vice-Principal of the combined department, becoming Principal in 1928, a position which he held until his death.

For his services to the Empire in connection with his work at the Bureau and the Institute he was awarded the O.B.E. in the 1936 New Year's Honours List, and for his work in the early years of his career in Ireland he recently received recognition by the award of an honorary science degree of the National University of Ireland. For many years Mr. Crook served on the Councils both of the Geological Society and of the Mineralogical Society and was elected Vice-President of the latter only two months before his death.

His publications, in addition to numerous contributions to the *Mineralogical Magazine* and other technical journals, included two books: *Economic Mineralogy* (1921), and *A History of the Theory of Ore Deposits* (1933).

Although most of his life was devoted to the service of the mineral industries of the Empire, Mr. Crook took a very deep interest in the fundamental problems of petrology, a subject upon which he held strong if somewhat unorthodox views.

We regret to announce also the death of two other eminent men of science who were connected with the Imperial Institute.

Sir Albert Kitson, C.M.G., C.B.E., a member of the Advisory Council on Minerals, who died on March 8, 1937, at the age

of 69, had long been associated with the Imperial Institute. Born at Manchester, he received his geological training at Melbourne University. After a period of service in the Geological Survey of Victoria, he became, in 1906, Principal of the Mineral Survey of Southern Nigeria, conducted under the auspices of the Imperial Institute. He retained this position until 1911, being responsible, meanwhile, for important work in connection with the investigation of the valuable coal, lignite and other mineral deposits of the Colony.

From 1911 to 1930 he was Director of the Gold Coast Geological Survey and it was here that he made what are probably his most important discoveries, viz., the deposits of manganese ore which proved such a valuable source of supply during the critical period of the War, the diamond-bearing deposits which now make important contributions to the world's supply, and the large deposits of bauxite which yet await exploitation. As the doyen of colonial geological surveyors, he received the honour of knighthood in 1927. His most outstanding contributions after his retirement from the Colonial Service were his two reports on the Kakamega Goldfield in Kenya.

He will be remembered by his associates for his genial personality and wide knowledge and experience which he was always willing to impart to all who sought his advice.

Sir Herbert Jackson, K.B.E., F.R.S., at one time Professor of Organic Chemistry at King's College, London, and later Director of the British Scientific Research Association, who died on December 10, 1936, in his 74th year, was also a member of the Imperial Institute Advisory Council on Minerals. He had been Chairman of the Advisory Technical Committee on Chemical Industries from 1925 to 1936, and had formerly served on the Board of Governors of the late Imperial Mineral Resources Bureau. During the War he carried out valuable work on the production of special glass for laboratory, optical and other purposes, in recognition of which he was created a K.B.E. in 1917.

Sir Herbert Jackson rendered valuable service to the Institute by freely placing at its disposal his extensive knowledge of the chemical, ceramic, and optical industries.

The Exhibition Galleries.—With the co-operation of Messrs. Austin Reed, Ltd., an exhibit has been arranged in the West Indies Court under the caption "Sea Island Cotton: the Story of a Shirt." This exhibit incorporates a series of photographs and specimens to show the cultivation of "Sea Island" cotton in the West Indies and its preparation for export. A mounted preparation of the seed with the lint attached shows the great

length, the fineness and the lustre of this staple. From the raw cotton the attention of the visitor is directed, by means of guide lines and arrows, to a series of specimens showing the treatment the cotton receives in the various manufacturing processes it undergoes until it emerges as shirting material. The story ends with a finished pyjama suit and a shirt with collars, all made from 100 per cent. "Sea Island" cotton.

A similar exhibit has been arranged in the Sudan Court, with the kind assistance of Messrs. Horrockses Crewdson and Co., Ltd., of Manchester. This illustrates not only the cultivation of cotton in the Sudan but the various stages of manufacture from raw cotton to the finished materials made in the Lancashire mills.

With the aid of the Travancore Minerals Co., Ltd., a new mineral exhibit has been arranged in the Indian Court illustrating the wide utilisation in industry of the beach sands of Travancore. In the centre of the exhibit is shown a quantity of crude black beach sand which is made to form the hub, as it were, of a wheel, the spokes of which, represented by coloured tapes, lead out to the various constituent minerals: ilmenite, monazite, sillimanite, zircon, rutile and garnet. Those again lead off by means of tapes to numerous chemicals and alloys, and finally to a great number of manufactured articles in which the sand derivatives fulfil an important function. Some of the many manufactures represented are: the well-known non-poisonous "Titanium White" with which the floor of the showcase has been painted; titanium filled paper which has been utilised for the labels; decorative colour finishes; white forms of letterpress ink, printed cotton fabrics, toilet soap, linoleum, rubber, leather, shoe polish and hard enamels; incandescent gas mantles; electric arc carbons; electrodes for arc welding; optical glass, including Chance's Crookes glass; sparking flints; refractory crucibles; smoke screens; medicines; and sandpaper.

To the South African Court has been added a large decorative wall-map which illustrates the chief mineral resources of the Union and the Mandated Territory of South-West Africa. The map is painted in soft pastel shades and proves an effective background for glistening vari-coloured symbols which indicate the chief minerals and centres of production. On two side panels are listed the principal metallic and non-metallic minerals, with their respective symbols. These lists not only serve as keys to the map, but by varying the size of the lettering some indication of the relative importance of each mineral has been given. When flood-lit the map forms a striking centre-piece to the displays of minerals grouped around it. A relief map of South Africa showing the chief oreographical features and political divisions has also been installed on

the floor opposite the mineral map in the centre of the Court.

Another exhibit added to this Court, with the kind assistance of Messrs. Lister and Co., of Bradford, traces the story of South African mohair from the time it arrives at a Bradford mill, through the various stages of sorting, scouring, combing, drawing, spinning, warping and weaving, to the form it finally takes, namely upholstery and furnishing fabrics of various kinds, rugs, imitation furs, coat linings, dress materials, covering for soft toys, etc.

Amongst a number of new photographs recently received for exhibition in the Galleries are a series showing local types of the Gambia population from negatives by Dr. T. H. Dalrymple, lent at the request of the Government of the Gambia; a series of scenes in Northern Rhodesia, prepared from negatives kindly lent by Mr. T. G. C. Vaughan-Jones, District Officer, Northern Rhodesia; several new additions to the Zanzibar clove series from the Clove Growers' Association; a series illustrating the cutting and transport of Eucalyptus coppice for the distillation of Eucalyptus oil from Dr. I. H. Boas, Chief of the Division of Forest Products, Council for Scientific and Industrial Research, Melbourne; and a series of Fiji native types and economic subjects prepared from negatives kindly lent by Mr. Kingsley Roth, late District Commissioner, Fiji.

Short Talks on the Empire at the Institute Cinema.—Teachers from overseas Empire countries and scholars in elementary, secondary and some technical schools in or near London are to be brought into contact once again this year through a series of talks in the Cinema on Thursday afternoons, from February to June. In much the same way that the Imperial Government draws upon the experience of Dominion and Colonial administrators when visiting London, the Imperial Institute seeks to make available, for the instruction of the children of London, the first-hand local knowledge of overseas students, teachers and professors who have "come home" for special courses at the Institute of Education. The series of talks given last year proved to be a great success, and another series, which will be equally as informal in character and as well illustrated by films and lantern slides, has been arranged in collaboration with Professor F. Clarke, M.A., Principal of the Institute of Education.

These talks will be as diversified as the geography, scenery and life of the British Empire. Mr. Arthur Thompson, Lecturer in Education, Auckland University College and the Seddon Memorial Technical College, has chosen for his title, "New Zealand: Auckland, Northern Gateway, and What Lies

Behind It." Mr. V. J. Cain, Horsham High School, Victoria, will conduct his audience on a "Trip to North-Western Victoria, Australia." Mr. F. S. Cillié, Lecturer in English and Afrikaans, Pretoria Technical College, will speak on "South Africa—the Country and its People," and Mr. H. G. Lomberg, Principal of the Hermanus Secondary School, Cape Province, will tell his young audiences something about his experiences "By Car from East London (South Africa) to Cape Town." Father Vincent Wall, of the Community of the Resurrection, will give an account of what he knows of Zululand from some years of intimate acquaintance with the country, and the Rev. G. E. Hay Pluke, Methodist Missionary in Northern and Southern Rhodesia, will give his impressions of these territories under the title of "Through Livingstone's Africa." Mr. G. E. Janson-Smith, lately Vice-Principal, St. Andrew's Training College, Minaki, Dar-es-Salaam, and now State Scout Commissioner, Cutch State, India, will give a lecture entitled "The Life of African Boys and Girls," and Syed Asaduddin, Headmaster of The Aga Khan's School, will talk on "Zanzibar—its Products and People." The Rev. Leonard J. Beecher, who for some years has been working in Kenya for the Church Missionary Society, will give an interesting account of "The Kikuyu People of Kenya," of some aspects of their tribal life and their part in the economic development of the Colony. India will be dealt with in a further talk by Mr. Janson-Smith on "Life in an Indian Village," and in one by Mr. E. Mahajan, Education Service, Bombay, who will refer particularly to the scenery, life and industries of the people of Bombay, Delhi, Agra and Calcutta. Ceylon will come into the picture in a lecture, "Island of Contrasts," by Miss M. H. Taylor, Principal, Methodist Mission High School, Badulla, Ceylon. "Through Canada by Rail and Motor Car," the subject of the address to be given by Professor C. A. Krug, Professor of Philosophy, Mount Allison University, New Brunswick, should provide some interesting glimpses of Dominion life to-day as he knows it.

Particulars as to the dates and times of these talks may be obtained by schools on application to the Assistant Secretary, Imperial Institute, South Kensington, S.W.7.

Empire Film Library.—Canada has responded to the appeal to Dominion and Colonial Governments to make good the shortage of films in the Empire Film Library at the Imperial Institute, by presenting 68 copies of twelve different films dealing with life in the Dominion. These are mainly copies of existing films, for which there has been a greater demand

from borrowers than the Library can supply. New Zealand has presented ten new films to the Library.

The Director of the Imperial Institute drew attention last August to the acuteness of the shortage, and to the fact that over 1,000 films already in the Library cannot meet anything like the full demands being made on its resources from 2,500 colleges, schools, technical schools, institutes and a variety of social organisations. The fact that about 3,500 copies of the Library's film catalogue have been sent out to normal borrowers and to new enquirers illustrates the extent of the demand.

The enterprise of the Canadian and New Zealand Governments in adding to their contributions to the Library will, it is hoped, be supplemented by additions from other parts of the Empire.

The following films which have now been released for non-theatrical circulation are available for general distribution: "Winter on the Farm," "Spring on the Farm," "Granton Trawler," "Cargo from Jamaica," "Windmill in Barbados," "Uncharted Waters—Newfoundland," "Esquimo Village" and "St. James's Park."

One of the most recent and interesting additions is the film, "Harvest of the Forest," which won last year for its producer, Mr. H. A. Burnford, the first prize awarded by the International Institute of Amateur Cinematography. This film will prove of value for classroom work, and the Institute is much indebted to Mr. Burnford for the presentation of a copy to the Empire Film Library.

Colonial Visitors.—The following is a list of officers on home leave from the Colonies who have visited the Institute during the three months November 1936 to January 1937 :—

NOVEMBER 1936

R. G. AIKMAN, Civil Establishment, Sarawak.
R. B. ALLNUTT, Agricultural Officer, Tanganyika Territory.
M. G. DE COURCY-IRELAND, Agricultural Officer, Uganda.
H. A. HAY-BARCLAY, Veterinary Officer, Nigeria.
R. JOHNS, Agricultural Officer, Zanzibar.
H. A. NICHOLSON, Department of Economics and Trade, Sudan.
F. W. T. POSSELT, Native Commissioner, Southern Rhodesia.
A. P. A. ROBERTSON, Inspector of Mines, Nigeria.
G. K. ROTH, late District Commissioner, Fiji.
W. C. SIMMONS, Senior Assistant Geologist, Uganda.
T. G. C. VAUGHAN-JONES, District Officer, Northern Rhodesia.
Captain J. G. WATSON, Conservator of Forests, Federated Malay States.

DECEMBER 1936

H. R. R. BLOOD, C.M.G., Colonial Secretary, Sierra Leone.
W. F. POULTON, C.B.E., Director, Veterinary Services, Uganda.

JANUARY 1937

N. CRAIG, Bio-Chemist, Sugar Cane Research, Department of Agriculture, Mauritius.
E. FREEMAN, Special Assistant (Tobacco Investigations), Mauritius.
N. HUMPHREY, Agricultural Officer, Kenya.
H. NANKIVELL, Deputy Colonial Secretary, Trinidad.
L. H. SAUNDERS, Acting Senior Agricultural Superintendent, Gambia.
R. B. WILLMOTT, H.M. Trade Commissioner, Singapore.
Dr. R. R. LE G. WORSLEY, Bio-Chemist, East African Agricultural Research Station, Amani, Tanganyika Territory.

All Dominion and Colonial officers, as well as private residents overseas, who may be visiting London, are invited to come to the Institute to see our Galleries or to discuss scientific and technical problems in which they may be interested.

The Official Marking of Empire Hides and Skins Prepared by Improved Methods.—The Imperial Institute Advisory Committee on Hides and Skins have had under consideration the subject of the certification (by marking) of hides and skins from Empire countries, which has special reference to securing the full benefit financially of improvements made in the preparation of these products. In this connection the Committee at a meeting held on October 14, 1936, passed a resolution in the following terms :—

> "It was unanimously agreed that it was desirable that hides and skins prepared by shade-drying or by an approved method of sun-drying should be marked under Government supervision as a guarantee of the method of preparation."

The necessity for official certification arises from the lack of confidence on the part of tanners in consignments of hides and skins offered as shade-dried, since it has been found that such consignments may contain a varying proportion of ordinary sun-dried hides which are of less value. This lack of confidence is reflected in the prices which the tanners are prepared to pay, and consequently the native producer of the shade-dried hides does not receive the full benefits of his extra labour in preparation.

The recommendation, as stated, applies also to hides and skins prepared by approved methods of sun-drying. This refers to the improved methods now being adopted in various countries of the Empire, whereby the hide or skin is stretched from a pole to the ground, as previously recommended by the Committee (see this BULLETIN, 1934, **32,** 53) or stretched on a frame and dried in the sun. By following this principle of suspension a product is obtained which is greatly superior to that prepared by the ordinary method of sun-drying, in which the hide is pegged out on the ground.

The hides and skins of this class are of good quality, comparable with that of shade-dried hides, and in order that they may establish a good reputation it is advisable that the risk of sophistication should be prevented by stamping them with a Government mark as a guarantee of the description. Further, such official certification would promote the sale of this class of hides and skins since it would be a means of definitely distinguishing the goods from the ordinary sun-dried hides of lower quality, and tanners who do not use the latter hides would be encouraged to take hides guaranteed as prepared by the improved method.

It may be pointed out that while hides and skins are in the dry raw state, the condition in which they are sold to tanners, it is not possible to distinguish with certainty between hides dried by various methods, and the curing faults of the ordinary sun-dried hides and skins first become evident during the tannery process. Hence a certification of the method of drying by a method of marking is needed.

The Committee recommend that the term " Suspension dried " be applied to hides and skins dried either on frames or stretched from poles (but not those hung over poles), in the sun or partly in the sun and shade, in order to distinguish them commercially from ordinary sun-dried hides and skins which have been dried by pegging out on the ground, and from the established class of shade-dried hides and skins. It is to be understood that the essential feature in the preparation of a hide or skin described as " Suspension dried " is suspension to allow the free circulation of air on both sides of it during drying. With reference to the method of marking hides and skins the Committee recommend the use of a hammer stamp; the space occupied by the numbers or letters of the mark must not be greater than about 1 in. by 2 in., and the marking should be made on the neck or shank of the hide or skin, and should be close to the edge.

It is further recommended that the inclusion, if possible, in the mark, of a letter or number to indicate the district of origin would be of value.

With a view to obtaining the opinions of the authorities in the more important producing countries of the Colonial Empire on the Committee's resolution and recommendations, the Secretary of State for the Colonies has issued to the Governments concerned a Circular Despatch embodying the foregoing statement. The Imperial Institute has also taken up the matter with the Governments of Southern Rhodesia and the Anglo-Egyptian Sudan. Observations on the proposals are already being received from the overseas governments and it is hoped in due course to issue a further statement on the subject.

The Coconut Industry in New Guinea.—A survey of the development and present position of the coconut industry in the Mandated Territory of New Guinea with a review of its prospects is contributed by R. E. P. Dwyer, Economic Botanist, Department of Agriculture, to the *New Guinea Agricultural Gazette* (1936, **2**, No. 2, pp. 1-72).

Coconuts are by far the most important crop in the Territory, and their cultivation is likely to be the main feature of plantation agriculture for many years to come. It is not possible to assess the total annual production of coconuts, but on the average over 60,000 tons of copra are being exported each year. The Territory is by far the largest exporter of this product in the South Seas and furnishes about 40 per cent. of the amount exported from all the British South Sea Islands. The highest production of copra was reached in 1927-28 when over 65,000 tons were exported, valued at nearly £1,200,000. This large quantity was due to the coming into bearing of the palms planted in 1917-18.

New Guinea differs from other coconut-growing countries in that the bulk of the planted areas consist of large European-owned estates. The plantations are situated along the sea coast and particularly in those parts which furnish the best anchorages. The number of plantations is approximately 430, with a capital value of about £5,000,000. The total area now under coconut palms is about 225,000 acres, representing an increase of 60 per cent. since 1917. The acreage increased very rapidly from 1914 to 1922 and then followed a period of gradual increase, but subsequently development has been retarded owing to the fall in price of copra. It is likely to increase if at any time copra prices become stabilised at a remunerative figure.

The factors influencing the fluctuating prices of copra and other vegetable oils are detailed. These cover a wide range of geographical, climatic and political circumstances. The chances of recovery and stabilisation of prices are discussed and the opinion expressed that, although the immediate prospects are reassuring, there is need for caution in assessing the long-term prospects of the industry.

It is interesting to note that the output of copra has not increased in the same proportion as the planted area. It is suggested that this is due to some extent to the older trees being beyond the stage of maximum production, with the result that the output of the old plantations is rapidly decreasing. Further, in many areas where copra has been produced for a considerable number of years, there is decided evidence of soil exhaustion, whilst some of the recently planted areas are giving poor yields owing to unsuitable soils or sites.

One of the greatest causes of wastage in the copra industry

in the Territory is the diversity of type of driers used, many of which are quite inferior and produce a poor quality product. Most of the driers in use are of the so-called " hot-air " natural draught type. The Ceylon type is employed on some plantations. It is recommended that experimental driers of various types should be erected in order to determine the causes of faulty construction and costly running. A definite need exists for some form of standardisation of the product by the use of driers which are cheap to construct, cheap to maintain and handle, and yet will yield a superior copra.

The average cost of production of a ton of copra is estimated at about £7 10*s*. to £8, although on some estates the figure is only £5.

New Guinea copra is submitted to a compulsory system of inspection and is sold on the London market as " hot-air-dried," " plantation sun-dried " and " common or smoke-dried." A fourth grade, known as " trade copra," is not recognised in London, but a large proportion of this quality goes to Marseilles. About 60 to 70 per cent. of the copra produced is " hot-air-dried," the price of which is always higher than that of South Sea copra ; on the average a premium of £1 can be relied upon. The difference in prices of the four grades is apt to vary from time to time; from April 1933 to January 1936 " hot-air-dried " commanded on the average 24*s*. per ton more than " smoke-dried," 18*s*. more than "trade" and from 2*s*. 6*d*. to 3*s*. 6*d*. more than " plantation sun-dried."

In 1934-35 nearly a third of the New Guinea copra was shipped to the United Kingdom ; Italy occupied second place with 22 per cent., Germany and Australia following with 13 and 12 per cent. respectively. The United States of America, which took 12 per cent. of the New Guinea production in 1929-30, have since 1933 ceased to import copra from this source. This is a result of American legislation.

It is suggested that the preparation of coconut oil might with advantage be started on a small scale in New Guinea and that it might be possible to find a market for this product in Canada, Australia and the East.

Attention is drawn to the need for an organised scheme of research dealing with copra and coconut products in the Territory. In such a scheme would be included chemical investigation of the soils, the growing palms, and the copra produced. Plant breeding, cultural and manurial tests, as well as detailed investigations on marketing problems and the insect and fungus pests present in the country should also be undertaken. It is admitted that a certain amount of work along these lines is being pursued, but it is felt that its scope should be enlarged.

There is also a definite need for an economic survey of all

bearing coconut areas in order to determine the true position and future prospects of the industry. It is not known what areas are actually paying their way, some plantations being situated on soils entirely unsuited to coconuts, or whether the good areas on certain plantations are carrying the bad low-producing areas on the same plantations.

The planting of new areas in New Guinea is advocated because of the peculiar suitability of the conditions for coconuts. Probably no more uncertainty prevails for the future of copra than for most oil-producing crops and it is advisable to maintain the present production. Land is cheap in New Guinea, as is labour, and there are still plenty of areas available which are suited for coconuts. Further, this crop is a simple culture which suits the labour available. It is the considered opinion of many competent authorities that there should be a good living for the coconut planter who is prepared to get the most out of his property.

Besides the production of copra the preparation of shredded and desiccated coconut is now a small but established industry in New Guinea, 1611 tons being manufactured in 1934-35. Three factories are devoted to this industry.

The World Production of Linseed.—According to a statement issued by the International Institute of Agriculture, Rome, the latest estimates of production indicate that the European linseed crop of 1936 was larger than that of 1935 and decidedly above the average. After a somewhat marked decline from 1929 to 1931 the extension of flax cultivation for seed in Europe has shown a steady recovery in nearly all the producing countries.

Among the countries which have especially intensified linseed growing special mention may be made of Germany, which, although this crop was introduced only a few years ago, already occupies the third place in European production (not including the U.S.S.R.), standing immediately after Poland and Lithuania.

There is no production estimate for the U.S.S.R., but, contrary to what has been the case in the flax-growing countries of Europe, the crop has been for some years on the decline. However, the information available as to the course of the season, which has been on the whole favourable to the development of the crop, and as to the measures adopted by the Soviet Government with regard to the improvement of the product in quality, points to a more abundant linseed harvest than that of 1935, and one also somewhat exceeding the average, calculated at 16,800,000 centals (29,900,000 bushels). The Soviet production of linseed, although considerable, has no importance for world trade, as its volume is

almost entirely absorbed by the requirements of the internal market.

In North America the present season has been characterised by very poor crops, due mainly to the exceptional dry weather in the spring and to the great heat of the summer. In the United States, the December estimate confirms an extremely slender production, scarcely 550,000 centals (1,000,000 bushels) more than the disastrously small crop of 1934. In Canada the estimate of production made in October shows an increase of about 21 per cent. as compared with 1935, but it remains lower by 24·6 per cent. than the preceding five-year average. Taken as a whole, the production of the two North American countries remains very poor, hardly reaching 4,300,000 centals (7,700,000 bushels), a decrease of more than 50 per cent. on that of 1935, which was calculated at 8,700,000 centals (15,600,000 bushels), and of 44·5 per cent. on the average figure of the previous five years, taken as 7,800,000 centals (13,900,000 bushels).

In Argentina the first estimate of production amounts to 41,400,000 centals (74,000,000 bushels). This estimate virtually coincides with the preceding five-years average, being scarcely 220,000 centals (400,000 bushels) lower, but exceeds by nearly one-third the definitive figure of last season, which was recently brought up to 31,400,000 centals (56,100,000 bushels). On the basis of the production as estimated in advance and taking into account the quantities which will be absorbed by the national linseed-oil industry and by the seed reserve and the almost negligible stocks of the past season, the Argentine Government has estimated at 38,100,000 centals (68,100,000 bushels) the exportable surplus for 1937.

Uruguay up to the present has not yet communicated to the International Institute any estimate of the area set aside for linseed in the season 1936-37. From non-official information, however, an extension of the area is expected, and good results seem likely, as in Argentina.

In India, which occupies the second place among the linseed-exporting countries, the season has been on the whole favourable to the crop but, owing to damage caused by bad weather at the time of harvesting, the volume of production shows a decrease of about 9 per cent. as compared with 1935, and of 1·3 per cent. as compared with the average, in spite of the fact that the area utilised for linseed has remained practically without variation as compared with previous years and exceeds the average by 9·1 per cent.

Among the African countries the most important linseed-growing country is French Morocco. Here, on an area nearly equivalent to that of last year but less than the average by some 22 per cent., a crop has been obtained exceeding by

29·6 per cent. the very small one of 1935, which was seriously damaged by the spring drought, but at the same time 28·4 per cent. less than the average of the five preceding years.

To sum up, taking account of the estimates already available, which refer to the majority of the producing countries, and of the information relating to the crop for the other countries which have not yet made production estimates, world production of linseed in 1936-37 (not including the U.S.S.R.) may be estimated at between 62 and 64 million centals (110 and 114 million bushels) as compared with 56·7 (101·2) in 1935, and 63·7 (113·8) on the average of the preceding five-year period.

It follows that, in spite of seriously short harvests in North America and of the losses which have reduced Indian production, the 1936-37 linseed season may be classed among the years of fairly abundant harvests, a position mainly due to the favourable results anticipated in Argentina and to the increase in European production.

International Grassland Congress.—The Fourth International Grassland Congress is to be held in Great Britain in July 1937, under the Presidency of Professor R. G. Stapledon, C.B.E., M.A., Director of the Welsh Plant Breeding Station and the Imperial Bureau for Herbage Plants, Aberystwyth, Wales. The paper-reading sessions will be held in Aberystwyth from July 13 to July 19, but intending participants will be able to join in a tour of centres of grassland interest and selected farms both before and after these sessions. The tours have been so arranged that participants will have an opportunity to see something of British grassland farming, including livestock management, over as wide a range as possible.

Special addresses will be given on certain evenings during the course of the tour, when matters of general interest emanating from the tours will be dealt with. These addresses will be given at Oxford, Cirencester, Aberystwyth and Newcastle.

The Congress Fee for the Fourth Congress is two pounds sterling, which will entitle members to attend all sessions and to receive the printed transactions, including all abstracts in advance of the Congress meetings, and any other incidental matter relating to the Congress. The Congress fee for wives accompanying members will be one pound sterling and will admit to full membership, but will not entitle such members to receive a copy of the transactions.

The paper-reading sessions to be held in Aberystwyth will be divided into three plenary and two sectionalised sessions. The sectionalised sessions will deal with the following aspects of the grassland problem: (1) Ecology (including surveys), pasture and range management (including erosion control);

(2) Seeds mixtures (including lucerne for grazing), legumes for use in poor pastures ; (3) Plant breeding, genetics, and seed production ; (4) Manures and fertilisers ; (5) Nutritive value of pastures and fodder conservation ; (6) Grassland economics.

All particulars regarding the acceptance of papers and dates for receipt of abstracts and paper manuscripts may be had from the Joint Secretaries, Agricultural Buildings, Aberystwyth, Great Britain, to whom requests for the Preliminary Programme and application form for membership and all other correspondence regarding the Congress should be addressed.

Barium Carbonate as an Insecticide.—Owing to the objectionable character of the residues left on fruit and vegetables by some of the well-known insecticides such as arsenates and fluosilicates, even after the products have been submitted to special washing processes, a constant search is being made, especially in the United States, for other substances, which, while effective as insecticides, shall be less harmful to human beings and domestic animals. In this connection, barium carbonate, which has long been known as a rat poison, has recently found extensive use, especially for the control of certain insects attacking the bean crop, and the results of careful trials of a form of this substance adapted for insecticidal use have recently been published. (" Barium Carbonate for the Bean Beetle," by L. M. Pearis, *J. Econ. Ent.*, 1936, **29,** 584.)

In laboratory tests, the material was found to be rather slowly fatal to Mexican bean beetles and their larvae (one of the most important insect pests of beans), while its effects on other species of insect were uncertain and in some cases apparently harmless. Similar results were obtained in field trials.

From the results of the tests, it was concluded that specially prepared barium carbonate does not equal the best of the standard materials such as magnesium arsenate and some of the fluosilicates, although satisfactory control, in moderate infestations at least, may be secured by its use. It is also more expensive and less easy to apply than these materials, and its use can be recommended only in cases where cost of material and amount of labour required are not important factors and where very poisonous residues are particularly objectionable, conditions which obtain with a great many growers of beans in the United States.

The Third World Power Conference, Washington, 1936.—The growth of international interest in the fuel resources of the world is patent from the many national papers and varied

topics which were discussed at the Third World Power Conference, held in Washington, U.S.A., in September 1936.

In Section I of the conference an interesting series of papers dealing with the trends of development in the utilisation of power resources indicates the various ways in which certain countries have employed the resources of power with which they find themselves possessed, either naturally or as the result of treaty-partitions. Thus, Switzerland makes the fullest use of its great water-power resources, though gas and coke, produced from imported coal, are widely used for domestic heating; and Austria, bereft of most of its former coal resources, has also turned to water-power to such an extent that in 1935 it represented 80 per cent. of the total production of power in the country. In the Argentine, oil takes a preponderant place as a source of energy since there is no evidence that coal exists there in exploitable deposits, and supplies of wood and water-power are too far removed from the centres of population to be of much economic value at present.

The growth of public control in the coal industry, in almost every coal-producing country, is evidenced in Section II. In Great Britain this has taken the form of central selling schemes for each coalfield, whereas in Germany the whole industry is under the control of the Reich Minister of Economy, and in Japan it is in the hands of three agencies, the Coal Mining Union (a production cartel), the Showa Coal Company (a sales cartel), and the Mutual Aid Association, all of which are subject to industrial control laws. Efforts to improve conditions in the United States coal industry by legislation have so far been invalidated.

The processing and distribution of coal and its by-products, of petroleum and related products, and of natural gas, are also treated in this section, which includes informative papers on such subjects as the processing of coal in Great Britain by coking in ovens, low-temperature carbonisation, gasification and hydrogenation, and on the low-temperature carbonisation of South Karafuto coal in Japan. In connection with petroleum, a useful article on the petroleum industry in Canada (Section II, Paper No. 5, W.181) gives an historical and descriptive account of the various proved and possible oilfields in the Dominion, and of the refining and distribution of the petroleum products.

The conservation of the fuel resources of the world forms the subject of Section IV of the Conference, in which the Director of Fuel Research in Great Britain details the work which is being carried out in this country to provide reliable and adequate information on the coals available for specific purposes, and Sir John Cadman (Paper 12) discusses the respective merits of the "unit" system of operation of oilfields

as compared with such schemes as apportionment of output on the basis of previous production and the apportionment of natural energy among oilfield owners, for the economic exploitation of petroleum deposits. It is also pointed out that recent estimates of the world's oil resources would seem to indicate the existence of something less than 20 years consumption.

Among other subjects dealt with may be mentioned: the economics and technique of gas manufacture, electricity generation, and the utilisation of water resources.

The Production of Columbite in Nigeria.—The Annual Report of the Mines Department of Nigeria for 1935 gives some interesting details concerning the production of columbite in that country. Nigeria is by far the principal producer of this mineral, the rising demand and new uses for which were fully dealt with in a recent number of this BULLETIN, 1936, **34**, 348-353.

During the year, 403 tons of concentrates were shipped to America. Several of the tin companies and individuals are now producing small quantities of columbite as a by-product of their tin winning, and some are applying for leases in respect of both tin and columbite.

The main producer of columbite ore is the Jantar Nigeria Company, Ltd., and during the year that company exported 360 tons. Their proved reserves already amount to approximately 6,000 tons. The next largest producer was Minerals Research Syndicate, Ltd., with an export total of 43¼ tons. Their proved ore reserves at the end of 1935 were stated to be 1,000 tons. During the year African Prospectors, Ltd., produced just over nine tons of concentrates, while Gold Coast Consolidated Lands, Ltd., and West African Mines and Estates, Ltd., commenced production in December 1935.

Columbite ore is usually found in conjunction with tin concentrates (the production of which is restricted at present), and legislation is under consideration which will permit the bonding of tin concentrates accruing during the production of columbite by producers who do not hold quotas in respect of tin.

Extraction of Potash and Alumina from Alunite by Fusion with Alkali Sulphides.—Numerous attempts have been made to use the mineral alunite, $K_2SO_4.Al_2(SO_4)_3.2Al_2O_3.6H_2O$, which occurs in considerable quantities in various parts of the world, as a source of potash salts, aluminium compounds or both. Various processes have been devised for this purpose.

Laboratory tests have shown that alunite can be decomposed by fusion with sodium or potassium sulphide ("Utilisation of Alunite through Fusion with Alkali Sulphides," by

E. O. Huffman and F. K. Cameron, *Industr. Engng. Chem.* [*Industr. Ed.*] 1936, **28**, 420). At first the process was carried out by reducing sodium sulphate to the sulphide by heating with coal and then fusing the alunite with this sulphide, but by regulating the conditions carefully, it was found that the whole reaction could be effected in one operation by heating a mixture of sodium sulphate, coal and alunite. The melt was leached with water, and the alumina precipitated from the resulting solution of sodium aluminate by treatment with carbon dioxide, but it was found to be difficult, if not impossible, to obtain a pure potassium salt from the residual liquor.

When potassium sulphate was used in place of the sodium salt, fusion was more easily effected, recovery of alumina approached the theoretical amount, and separation of potassium as a pure salt was practically complete. Further experiments on a larger scale have shown that alunite can be sintered, without need for fusion, with potassium sulphate and coal in an alundum-lined furnace ("Utilisation of Alunite through Alkali Fusion," by J. A. Taylor and F. K. Cameron, *Industr. Engng. Chem.* [*Industr. Ed.*], 1936, **28**, 1238). Part of the potassium sulphate may be replaced by potassium carbonate with advantage. The sinter can be leached with water, and alumina precipitated from the liquor, in a satisfactory state of purity, by means of carbon dioxide, the residual liquors containing potassium sulphate and potassium carbonate.

Since the solubility of potassium sulphate is greatly decreased by the presence of the carbonate, it is possible to recover the potassium sulphate from the solution almost quantitatively and in a high degree of purity. The residue of potassium carbonate with a small proportion of sulphate can be used satisfactorily for decomposing a further quantity of alunite.

Coal in the Transvaal.—The Middelburg-Witbank area of the Transvaal is by far the largest producer of coal in the Union of South Africa, contributing no less than two-fifths of the total output. The field is situated about 100 miles east of Johannesburg and, though outcrop-coal had been won prior to the discovery of the Rand, mining was first seriously undertaken after gold had been found, four mines being in operation in 1889.

The coal-bearing strata cover an area of 800 square miles, and it has been estimated that some 760 million tons of coal of a calorific value exceeding 11,000 B.Th.U. (12 lb./lb.) are present, as well as about 5 million tons of inferior grades. The five or more seams which have been proved in the Witbank field are contained in a series of shales, sandstones, grits and

conglomerates known as the Middle Ecca Series of the Karroo system.

The seams are at shallow depth, the deepest point of the basin being 400 ft., and denudation in the main river valleys has resulted in breaking the seam-continuity, exposures occurring fairly frequently in the river escarpments. Towards the margins of the area the seams rise in level as much as 140 ft. in the south and 250 ft. in the north, with the result that in these localities all seams above No. 2 have been almost completely denuded. In the shallower mines " washouts " due to sub-surface weathering by ground waters are common, as are " rolls " in the deeper seams, and dolerite dykes occur commonly in the southern parts of the field and to a lesser extent in the north. Of the five seams the basal pair are of chief importance.

No. 1, or the Navigation Seam, which is present only in small areas in the south and west of the field, ranges in thickness from 2 to 11 ft. but is not worked when less than 3½ ft. thick. The coal, which is remarkably clean and uniform, is dull, non-coking and slow-burning, and has the following analysis :

Moisture . . .	1·33 per cent.
Ash . . .	13·02 ,,
Volatile matter .	24·65 ,,
Fixed carbon . .	60·15 ,,
Sulphur . . .	0·85 ,,

Calorific value = 12·8 lb./lb. (12,377 B.Th.U.)

The Main or No. 2 seam varies in thickness from 14 to 30 ft., of which from 6 to 11 ft. are mined. It is of a composite nature, being banded, with a basal layer of bright, high-grade gas-coal overlain by a thinner band of dull, inferior splint-coal and an upper layer of bright steam-coal. As much as 15 ft. of this seam is worked at two collieries, but in several others only the lower 4 to 6 ft. can be worked. The coal has the following analysis :—

Moisture . . .	1·0 per cent.
Ash . . .	12·2 ,,
Volatile matter .	30·1 ,,
Fixed carbon . .	55·7 ,,
Sulphur . . .	1·0 ,,

Calorific value = 13·0 lb./lb. (12,588 B.Th.U.)

In the mines to the west of Witbank, viz. Clydesdale, South African Coal Estates and Coronation, the Navigation Seam is the more valuable. At Schoongezicht both seams are worked, while to the east, in the Middelburg Steam, Witbank, and South African Coal Estates (Landau) collieries the Main Seam is worked, the Navigation seam either disappearing or being too dirty.

Of the three upper seams only No. 5 is of any economic importance, No. 3 being a narrow seam about 1 ft. thick and

of irregular occurrence, and No. 4, well known for its high dirt content, is commonly split into two or three divisions by grit partings, but attains a thickness of as much as 24 ft. No. 5 seam, which is some 130 ft. above the Main seam floor-level, averages 6 ft. in thickness, but is present only in a few areas owing to denudation. The lower parts of the seam are of good quality and exhibit satisfactory coking properties.

According to the *Annual Report* of the Government Mining Engineer for 1935, seventeen collieries are operating in the Witbank field, four of which are producing over 3,000 tons daily in one shift.

Coal is also being produced in the Springs-Brakpan area, which ranks second to the Witbank area in size of production, as well as in the vicinity of Ermelo, Belfast, Vereeniging and Heidelberg.

In the Ermelo district certain coal seams carry bands of torbanite which is mined for distillation purposes, previously described in this BULLETIN (1936, **34,** 73-74). At present there are six concerns actively engaged in coal production, and one company, the South African Torbanite, Mining and Refining Co., Ltd., is producing torbanite from a mine on Farm Mooifontein No. 287, from which some 14,000 tons of torbanite and 19,000 tons of the overlying coal have been won. On the portion of the farm held by the Company the torbanite band averages about 18 in. in thickness and reserves are estimated to amount to 4,097,000 tons.

Trials on Scottish Cannels.—Cannel coals occur in certain of the Scottish seams as irregular bands of variable extent, which are distinguished by their conchoidal fracture, lack of lustre and relatively high yield of distillation products. These coal bands were at one time widely worked, but to-day the presence of such a band in a seam is not usually considered to improve its value.

As the result of a questionnaire circulated to coal companies in Scotland by the Oil from Coal Committee of the Scottish Development Council, the following tables of production and reserves of cannel coals, including parrot or gas coals and torbanites, were compiled. (Second Report of the Oil from Coal Committee of the Scottish Development Council, 1936).

Cannels containing less than 8 per cent. of Ash and yielding over 40 gal. of Crude Oil per ton

Area.	Daily production in tons. Present.	Estimated maximum.	Estimated reserves. *Tons.*
Lothians	268	905	20,512,600
Fife	49	123	467,000
Lanarkshire	50	50	500,000
Ayrshire	—	300	4,000,000
Other areas	60	60	22,800
Totals	427	1,438	25,502,400

Cannels containing more than 8 per cent. of Ash and yielding over 40 gal. of Crude Oil per ton

Area.	Daily production in tons. Present.	Estimated maximum.	Estimated reserves. Tons.
Lothians	175	260	6,843,000
Fife	30	1,140	43,524,300
Lanarkshire	102	220	1,235,210
Ayrshire	—	—	—
Other areas	—	50	56,000
Totals	307	1,670	51,658,510

In addition to the above, and in the same areas, reserves of material containing less than 8 per cent. of ash and yielding from 20 to 40 gals. of oil per ton, amount to over 12 million tons (of which 11 millions are available in the Lothians), together with some 4½ million tons of material containing over 8 per cent. ash and of the same range of oil yield.

The object of the Committee is to provide a supplementary source of oil for the nation by methods which, if possible, do not involve the production of a by-product which would displace ordinary coal, and therefore the utilisation of cannel and non-caking bituminous coal seems specially promising. Hydrogenation is one such process, but others are available which employ coal or coke as a source of water-gas for catalytic conversion to oil, and reference is made in the Report to the use of cannel coal for this purpose.

Some time ago an extensive series of trials was carried out at the Granton Gas Works of the Edinburgh Corporation by Jamieson and King (*Instn. Gas Engineers Communication* 135, 1936), which established the fact that Midlothian cannel coal when treated in vertical retorts into which steam is passed, yields an oil amenable to hydrogenation and a coke inferior to standard varieties, but which could be employed for the generation of water gas. With the retort temperature varying from 1,179° to 1,394° C. and the steam admitted from 13·7 to 30·8 per cent. by weight of the charge, the actual yields were from 41·3 to 54 gals. of crude oil, and from 7·95 to 9·16 cwt. of coke per ton of cannel carbonised. In addition, 5·17 gals. of crude motor-spirit were obtained per ton of cannel, by stripping the gas produced.

Thus, by carbonising cannel, almost double the quantity of crude oil obtainable from similarly treated bituminous coal can be produced, together with a coke which could probably be employed as a source of hydrogen and carbon monoxide for the synthesis of hydrocarbon oils by such methods as the Fischer-Tropsch.

It is estimated that in order to function economically a full-scale plant of this description would be required to produce 60,000 tons of primary oil a year, and to enable this to be done

approximately 2,000 tons of cannel per day and a reserve of 24 million tons would be needed. The tables indicate that only the Lothians or Fife are in a position to meet such a demand.

With an anticipated daily output of 3,000 tons of cannel and assuming complete oil and coke treatment, it is calculated that the annual production of motor spirit would be 70 million gals., as compared with an output in 1935 from all indigenous sources of 76 million gals.

The contribution which this would make towards national demands may be noted by comparison with the imports of petroleum spirit into the United Kingdom in 1936 which amounted to 1,273,195,000 gals.

Iceland Spar in South Africa.—Supplies of optical calcite are now principally obtained from the Union of South Africa. The numerous small occurrences have been described in the *South African Mining and Engineering Journal*, 1936, **47**, 458-459.

The deposits are distributed sporadically over the north-west of Cape Province, in the divisions of Kenhardt, Calvinia and Namaqualand. Most of the output comes from a district about 60 miles south-west of Kenhardt, where the mineral is found on the farms Dagab, Korannakolk, Paardevley, Loafskolk, Verdorsputs and Klerkshoop. Other deposits occur near Aliwal North, Lady Grey and Rosmead, some 400 miles to the east. The masses of clear crystalline calcite are carefully removed from shallow, open workings and are given a preliminary trimming on the spot. The export agents remove as much as possible of the remaining waste material. The crystals are very sensitive to shock and pressure since they cleave easily and tend to develop polysynthetic twinning, with the result that the large number of inexpert miners engaged in winning the mineral waste a large proportion of the crystals by injudicious blasting and the wrong use of tools. This same sensitiveness of calcite probably accounts for the fact that other South African deposits of clear calcite have been spoiled by earth movements.

The Iceland spar is used for the manufacture of Nicol prisms for petrological microscopes, polariscopes, colorimeters, photometers, saccharimeters and other optical instruments. These require perfect rhombs of clear crystal weighing not less than ¾ oz., a size which can usually be cut from 2 oz. untrimmed crystals. Therefore a deposit, to be economic, must contain a large number of crystals greatly exceeding 2 oz., as the small sizes do not command a sufficiently high price to cover the cost of mining. Most of the South African output has been exported in small quantities by post, so that there are

no records of production. It has been estimated, however, that during the last twenty years nearly a ton of Iceland spar has been exported from the Union.

The Use of Calcined Dolomite in the Treatment of Water.—Certain naturally occurring waters which have been used as sources of public supplies have a marked corrosive action on lead and iron pipes or storage tanks, and in many cases this corrosion has been proved to be due to the presence in the water of free carbon dioxide in excess of that necessary for the maintenance of equilibrium with calcium and magnesium bicarbonates. Many methods of removing or neutralising this excess of carbon dioxide have been proposed, one of the most recent being described by A. F. Meyer (*Chem.-Zt.*, 1936, **60,** 742-5).

In this process, dolomite is submitted to a controlled calcination and a porous product is obtained, which consists essentially of magnesium oxide and calcium carbonate. This product, which is used in filters, is found to react with the free carbon dioxide in water, forming soluble bicarbonates. The treatment thus increases the carbonate hardness of the water but renders it non-corrosive. Very little of this filtering material is dissolved in the treatment of an average water containing carbon dioxide, and the filters which have been developed on the commercial scale can operate for long periods without renewal.

Water so treated not only loses its corrosive properties but is said to be capable of depositing a thin protective layer in iron pipes which have begun to corrode. The film of iron oxide formed by corrosion appears to absorb some of the combined carbon dioxide from the treated water, disturbing the bicarbonate equilibrium and causing the deposition of a thin layer of calcium carbonate, which prevents further action.

Many natural waters which contain an excess of carbon dioxide, hold iron and manganese in solution as bicarbonates. When such waters are passed through one of these filters, iron and manganese are removed and are deposited as a loose hydroxide sludge which can be periodically rinsed out from the filter. It is also claimed that lead and copper can be removed from water in the same way, and this property of the filter should be of service when the copper sterilisation process has been employed.

In Germany a number of waterworks and industrial plants are stated to have recently installed these filters with satisfactory results.

Activated Alumina for removing Fluorides from Drinking Water.—The possibility of fluorine poisoning due to fluorine-bearing waters is now recognised as a problem of public health.

The results of tests which, it is claimed, demonstrated the

effectiveness of a specially prepared activated alumina for the removal of fluorides (C. J. Fink and F. K. Lindsay, *Industr. Engng. Chem.* [*Industr. Ed.*], 1936, **28**, 947) are therefore of interest. The apparatus employed was similar in construction to the now well-known household type of zeolite water softener, built of vitreous enamelled sheet metal. For fluoride removal it was charged with a 6 in. bed of activated alumina retained within metal screens, the average charge weighing 9·75 lb. In order to test the efficiency of the alumina, water containing 5 parts per million of fluoride was introduced at the top and flowed by gravity through the bed at a maximum rate of 0·4 gall. per minute. It was found that two hundred and fifty galls. of water passed through the apparatus before the amount of fluoride in the effluent reached 1 part per million, an amount which seems to be generally considered to be the maximum permissible limit; regeneration or replacement of the alumina then became necessary.

Experiments showed that a solution of sodium chloride exhibited practically no regenerating effect on the alumina, but both sodium chloride solutions acidified with hydrochloric acid, and hydrochloric acid solutions of one per cent. concentration, restored 90 per cent. of the original capacity. Complete regeneration was accomplished with either an 8 per cent. solution of sodium hydroxide or with an alkaline solution of sodium aluminate having a total alkalinity equivalent to 8 per cent. of sodium hydroxide. The application of regenerative treatments to small household units does not at the moment appear to be feasible, and although regeneration of such units might be possible, the preferable procedure would apparently be to replace the alumina after a definite period of use.

Preliminary investigations of the possible application of activated alumina in larger units, such as central treating plants, indicated that such installations combined with regeneration might be practicable, but no definite recommendations could be made.

It was found that the efficiency and capacity of activated alumina were dependent on the hydrogen-ion concentration of the feed water, the addition of alkali resulting in a decrease and that of acid in an increase, the hydrogen-ion concentration of the effluent remaining constant at 7·5. The authors therefore suggest that the acidification of the water to be treated offers interesting possibilities.

No information is given in the article regarding the nature or preparation of the activated alumina.

Production of Ion-Exchange Materials from Lignite, etc.—Base exchange materials of the zeolite type have been in common use for water-treatment for many years, their value

lying in the fact that they effect the replacement in hard water of calcium and magnesium ions by ions of the alkali metals, usually those of sodium.

The presence of the sodium salts contained in the softened water is, in many cases, of no importance, but for certain purposes it may be desirable to obtain water free from all bases. For the attainment of this result it is necessary to employ a material possessing the property of hydrogen-ion exchange, but hitherto the only known substances of this class have been those obtained by the acid-treatment of certain siliceous materials. These have, however, not been successful in practice, owing to their rapid deterioration.

It is therefore interesting to note that a new class of ion-exchange materials stated to possess high ion-exchange capacity (including the capacity of exchanging hydrogen-ions) is described in a recent patent (E.P. 450,574 of 1936, granted to United Water Softeners Ltd., London).

These substances are prepared by the treatment of naturally-occurring decomposition-products of vegetable origin with an excess of strong sulphuric acid, or a reagent having a similar chemical effect. The organic materials which can be used include peat, lignite, coal and anthracite, and the reagents, in addition to sulphuric acid, include many of the inorganic sulpho-acids and their anhydrides, or mixtures of these. In particular, sulphur trioxide, fuming sulphuric acid, oleum and chlorsulphonic acid are stated to be especially suitable. The ratio of sulphuric acid (or its equivalent) to carbonaceous matter should never be less than 3 to 1, and should preferably exceed 10 to 1. In all cases, the reaction should be terminated before there is any appreciable formation of free carbon, and, usually, the temperature should not exceed 150° C. The final product is considered to be, in general, an organic sulphonic acid, or a sulphuric acid ester.

When the reaction has proceeded to the desired point, the sulphuric acid is removed, as far as possible, by filtration through acid-resisting filters, and the reaction-product is washed with water until all soluble matter is eliminated. Before, or during, the acid treatment, an inert substance, such as kieselguhr, may be mixed with the carbonaceous material, and the treated mass can then be moulded. Substances such as cellulose xanthogenate or silica-gel may also be added.

The employment of the products obtained in this way, for the treatment of water and aqueous solutions, is described in a further patent (E.P. 450,575 of 1936), in which it is claimed that they cost less to prepare than the usual zeolites, that they are capable of exhibiting a base-exchange capacity exceeding that of any natural base-exchange material at

present known, and that their use is not limited to the usual purposes of water softening. It is further claimed that, unlike siliceous materials, the new products suffer no deterioration as a result of repeated regeneration. The regenerative reagents employed may be sodium chloride or other appropriate salt, or a dilute acid, according to the purpose in view. The following examples indicate the variety of operations which, it is claimed, may be carried out with these new materials.

(1) If water containing sulphates, chlorides, and carbonates is passed through the hydrogen-exchanging material, the effluent water contains sulphuric, hydrochloric and carbonic acids equivalent to the salts originally present. Carbonic acid may be removed by heating, and the other acids precipitated as insoluble salts which may be removed by filtration, leaving the water practically free from all acids and salts.

(2) By a modification of the above method it is possible to obtain water containing only, or principally, sulphates in any requisite quantity, a property which is of importance for certain industrial purposes.

(3) Alkaline water, obtained by passage through ordinary zeolites, or otherwise, can be mixed with water which has been passed through a hydrogen-ion exchange material, and from which the carbonic acid has been subsequently removed by heating. This process affords a soft, neutral water.

(4) Acid water, obtained as an effluent from one of these filters, is allowed to flow quickly over marble, or other alkaline-earth carbonate. The free sulphuric acid reacts with the carbonate more rapidly than does the carbonic acid, and the resulting water acquires sulphate-hardness. This can be increased by the addition of gypsum, or by the addition of sulphuric acid to the water before the passage over marble.

RECENT RESEARCH ON EMPIRE PRODUCTS

A Record of Work conducted by Government Technical Departments Overseas

AGRICULTURE

BEVERAGES

Cacao

Gold Coast.—The report of the Department of Agriculture for the period July-December 1936 contains the following statement relating to a possible new disease of cacao.

In September 1936 a farm in the Eastern Province was inspected in which some 200 cacao trees had died off, according

to the owner, during the past two years. The death of the trees was associated in several cases with a curious malformation of young chupons, which showed regions of abnormal swelling separated by constrictions. The constricted parts vary from one to several inches in length, and may be less than ¼ in. thick, while the swollen parts may attain a thickness of more than 1 in., even in very small chupons, and are usually about equal in length to the constrictions. The transition from the swollen to the constricted parts is gradual.

A survey of the district and enquiry among farmers have so far resulted in the location of some 38 farms where the phenomenon may be observed in patches of dead and dying trees. In these areas the swollen chupons are by no means general and can only be found on a few trees, but they have not so far been observed anywhere but in association with areas where trees are dying back. Cases have been reported where the swellings occur on young seedling cacao planted to replace dead trees, and on the chupons of apparently healthy trees.

The Plant Pathologist working on the affected material has isolated a fungus similar to those known to be the causative agents of "wither-tip" in crops other than cacao, and inoculation experiments and observations are proceeding. In the absence of definite proof as to the cause of these new symptoms in cacao, precautionary sanitary measures are being adopted on affected farms, consisting of destruction of dead and dying trees and drastic pruning of trees suspected as contacts.

The same report records the results of an experiment which has been carried out at the request of the British Association of Research for the Cocoa, Chocolate, Sugar Confectionery and Jam Trades, to ascertain the degree of infestation by cacao moth (*Ephestia* spp.) at various points between producer and consumer. A commercial bag (140 lb.) of broken germinated beans was collected from the farmers' drying trays at each of two centres in the Eastern Province. Each bag was then stored for a period of approximately one month in a farmer's store, three weeks in a merchant's up-country store, and three weeks in an export-store at the port before being shipped to London. Each bag was sampled at the commencement and after each period of storage, samples being sent to the British Association of Research, who reported on each, as well as on the remaining contents of the bag. Although all beans were either cracked or germinated, and, therefore, all liable to infestation by cacao moth, damaged beans amounted to only 3 per cent. after a period of four months from collection to arrival in London. Results indicate that the chief infestation takes place in farmers' stores.

Coffee

Sierra Leone.—Mr. C. Hargreaves, Entomologist to the Department of Agriculture, in his report for the period July-December 1936 states that the berry borer of coffee, *Deudorix bimaculata* Hew. (Lycænidæ), shows a marked increase. This is connected with the presence of its natural food plant, which was found to be *Heinsia pulchella* (Rubiaceæ). Eradication of this plant from areas surrounding coffee is advised. The only natural enemy of the borer which has been seen is a hymenopterous parasite of the eggs.

CEREALS

Bulrush Millet

British Somaliland.—Mr. E. F. Peck, Veterinary and Agricultural Officer, in a report for the half-year ended June 30, 1936, states that samples of bulrush millet (*Pennisetum typhoideum*) were distributed last year in an endeavour to introduce to the Somalis a grain which would be bird-proof and one which is not subject to the pests of jowari. The resulting yields have been good and the crop stood the Kharif well. Unfortunately, the stalk is rather weak and a variety which is better in this respect is being obtained. A bird-proof staple crop of this kind will do much to save the trees in garden areas as one of the chief reasons for tree felling is that they harbour birds.

Jowari (*Sorghum*)

British Somaliland.—The following statement is also taken from Mr. Peck's report for the half-year ended June 30, 1936.

Sholapuri jowari, which grows so quickly and successfully in Hargeisa, does not appear to grow so well in the Hahi-Bereto areas. A further distribution of heads for trial is being made.

One of the results of the single crop system has been the multiplication of jowari parasites, and amongst the most important of these is a lepidopterous stalk borer (a *Sesamia* sp.—which is not in the British Museum collection). Control of this pest lies finally in the removal of the dead stalks after harvest, as the larvæ winter in these, and secondly in the diversification of crops. The latter is the more hopeful approach.

Another insect, *Agonocelis versicolor* F., which was seen in Borama, is capable of being a really important pest of jowari. The Sudan Government Entomologist states : " After a period of years during which it has attracted no attention it may occur in vast numbers and destroy entirely the rain-grown dura over wide areas." Control of the pest lies in

spraying, but as this is impractical in Somaliland the best control lies in diversification of crops grown. The Government purchase of as much produce as possible will assist towards this end, as if farmers lose the jowari crop they will still have gram, beans and similar crops upon which to fall back.

Four types of smuts which attack jowari in Somaliland have been identified in England, and treatment for the chief of these serious parasites is available. Milo jowari, which is immune to head smut, is being obtained for trial. The incidence of smut appears to be lower this year than last.

Rice

Sierra Leone.—According to the report of Mr. C. Hargreaves, Entomologist to the Department of Agriculture, for the half-year July-December 1936, an outbreak early in July of the Pentatomid, ? *Nezara chloris* Westw., threatened the upland rice crop. The attack, fortunately, was not universal, although considerable damage was done in limited areas. The normal food plant of this insect appears to be *Rottboellia exaltata* and all stages of the insect were to be found on it as soon as flowering commenced in early October. No later damage to rice was reported. Breeding apparently ceased at the beginning of December. An egg parasite was the only natural enemy encountered.

Pulses

British Somaliland.—In a report for the half-year ended June 30, 1936, Mr. E. F. Peck, Veterinary and Agricultural Officer, states that there has been a great increase in the acreage of ground put down to gram, and about every second farm visited was growing a substantial plot. If this crop yields well it is the intention of the Government to buy it. This will put gram growing permanently into the crop rotation of the farmers, and incidentally will provide money with which they can improve their agriculture. The increase in gram is due to propaganda and the belief that the Government will buy Somali gram instead of that from India.

The pigeon pea (*Cajanus indicus*), a perennial crop, was grown by Mr. McCallum in Hargeisa. It stood the Kharif well and is a very useful crop to grow with jowari. Unfortunately, the crop became parasitized, but a new clean sample is being obtained and the old one made into hay. Pigeon peas may eventually be grown extensively by farmers.

Root Crops

Cassava

Gold Coast.—The following statement regarding cassava mosaic trials is contained in the report of the Department of Agriculture for the period July-December 1936.

Two series of cassava seedlings, bred by the Botanist for resistance to cassava mosaic disease, have been under test at the experiment stations of the Department. The first series consisted of 32 seedlings produced in 1933-4. These were tested from September 1934 to March 1936 at three of the experiment stations, and six of the 32 were not attacked by mosaic at any station during this period. These six strains have now been for eight months the subject of a more severe test on four different stations, rows of the strains being alternated with rows of highly-infected local material, in other words under optimum conditions for attack. Mosaic counts on the growing material to date may be summarised as under :—

Strain.	Percentage infected at all stations.
M11	52·5
M14	21·9
C50	8·2
C52	16·6
C192	7·6
C282A	11·2

Not one of the strains has, therefore, maintained its complete immunity in this severe test. The results given above refer to total infection and do not distinguish between tolerant and intolerant plants, i.e. those which do not or which do suffer severely when attacked. Judging by appearance strain M11 is not only the most susceptible but is also very severely attacked, whilst C50 and C52 are only slightly attacked. When the crop is harvested at the end of the season a better estimate of the degree of tolerance will be possible.

The total incidence of disease varied greatly at different stations and the incidence of disease on any one strain at different stations was also striking. The results suggest the tentative conclusions that the strains of virus causing disease may differ in various parts of the country and may also have varying degrees of virulence, that the incidence of the vector may vary, and also that there may be a differential varietal susceptibility.

In a second series of 36 seedlings bred in 1934-5 a limited quantity of material has been the subject of a similar severe test at five different centres. At eight months the details of infection at all stations can be summarised as below :—

Total number of seedlings tested	36
Number not attacked at any station	13
Number attacked at one station only	5
Number attacked at two stations only	9
Number attacked at three stations only	7
Number attacked at four stations only	1
Number attacked at all stations	1

As with the first series the total incidence of disease varies greatly at different stations, and it is obvious that the varietal susceptibility also varies considerably.

Drugs

Kola

Sierra Leone.—According to the report of Mr. C. Hargreaves, Entomologist to the Department of Agriculture, for the period July-December 1936, trials of fumigation of kola nuts against the weevil, *Balanogastris colæ* Desbr., give promise. Treatment for five hours in a 3 per cent. vapour concentration of carbon bisulphide killed all stages without deleterious effect on the nuts; four hours exposure failed to kill the eggs.

For treatment against the adult weevil in stores the use of sodium silicofluoride as a dust on the floor is likely to prove effective, the majority dying within three days after walking across a zone 2½ in. wide; all died within a week.

MINERAL RESOURCES

GOLD COAST

The Institute has received the following statement from the Director regarding the work carried out by the Geological Survey Department during the six months ended December 31, 1936.

During the greater part of the period under review the Director and geologists were either on leave or engaged in research on the material collected during the previous field tour. One geologist was in the field for four months and the Director and one geologist for one month each. The field work included the geological mapping of the Tarkwa goldfield and the Nsuta manganese-ore deposits, and also traverses with a vertical-force magnetic variometer across the Tarkwaian beds between Effuenta and Adja Bippo.

Tarkwa Goldfield.—Field work in the Tarkwa Goldfield was concentrated on geological mapping combined with mine and borehole examination.

The structure is one of pitching folds, with overthrust faulting near the edge of the geosyncline. Towards the southern end of the geosyncline, up to the line of Akontansi, there are three main structural elements, a central northerly-pitching anticline (the Anantanfro anticline, which brings up Upper Birrimian beds to the south), flanked on the north-west and south-east by the Huniso syncline and Tarkwa syncline, respectively.

In the neighbourhood of the Akontansi escarpment, the central anticline forks and gives rise to two anticlines, the Mantraim anticline to the south-east and the Kotraverchy anticline to the north-west, separated by a syncline, the Akontansi syncline.

The Mantraim anticline, which is flanked by strike faults, pitches north-eastwards, and the Banket Series beds disappear beneath Tarkwa phyllite near the Sumang river. The axis of the anticline converges towards that of the Tarkwa syncline, and from the Sumang river to the neighbourhood of Fanti mine, it would appear that these structures are replaced by a strong overthrust fault, which brings up Banket Series beds in the midst of Tarkwa phyllite.

The Kotraverchy anticline and the Akontansi syncline are persistent features traceable well to the north of the Huni river. The Huniso syncline, west of the Kotraverchy anticline, also persists north-eastwards, but is truncated on the west by a big overthrust fault. The beds north-west of this fault, in contrast with those to the south-east of it in the Tarkwa goldfield, are strongly overfolded, and between Huniso and Ankobra Junction there is constant repetition of Tarkwaian beds, with Upper Birrimians showing in some of the anticlines. It is probable that the intrusions of gabbro between Huni Valley and Huniso have determined the locus of this overthrust, and protected the Tarkwaian beds to the east.

In recent years some doubt has been cast on the existence of Whitelaw's Dompim phyllite and Dompim quartzite, which he placed at the top of the Tarkwaian System above the Huni sandstone. The mapping shows, however, that the Dompim phyllite exists, but that its thickness is very much less than estimated by Whitelaw. Furthermore, no real difference can be detected between the Huni sandstone and Dompim quartzite, and the Dompim phyllite is more correctly regarded as a band of phyllite separating upper and lower divisions of the Huni.

Geophysical Investigations.—The magnetic observations indicate that the Birrimian greenstones are normally only weakly magnetic and that the sheared dykes in the Tarkwaian and also the banket conglomerate and wall rocks, cause only minor anomalies. Strong anomalies are caused, however, by younger intrusions of gabbro, epidiorite, and dolerite, where they are fresh or only slightly metamorphosed, and by rare magnetite-rich bands in the Tarkwa phyllite.

Publications.—*Bulletin* No. 7, " The Bauxite Deposits of the Gold Coast," has been published, and *Bulletin* No. 8, " The Geology of the Bosumtwi Caldera and surrounding Country," is now being printed.

NIGERIA

The Imperial Institute has received the following statement from the Acting Director regarding the work carried out by the Geological Survey during the second six months of 1936.

Gold.—No further field work has been carried out in the goldfield during the period but work will be resumed in the new year. There has been some reduction in the gold output, the total yield for the year being 33,365 oz.

Lead-Zinc.—Electrical prospecting was carried out on the mine of the Northern Nigerian Lead Mines, Ltd., at Zurak, Admawa Province. The results appear to indicate that there are further reserves of ore. It is to be hoped that the company will test the validity of these results by a programme of exploration.

Water Supply.—The sinking of wells for the improvement of water supply in the Northern Provinces has been continued. During this half year 83 new shafts have been completed, bringing the total for the year to 149, with a footage of approximately 18,375 feet.

In Sokoto Province, work was again confined to the extreme north-west of Sokoto Emirate and to the adjoining portion of Argungu Emirate. Owing to the poor water supply, this area was one of the most backward in Nigeria. The new wells are proving successful in encouraging immigration. In Katsina Province, attention has been directed principally to the construction of wells in areas of crystalline rocks in Ruma and Kaita Districts. A nine-foot diameter shaft is in course of construction at Katsina and is the first step in a scheme to provide a pipe-borne water supply for Katsina Town (population 22,000) and Katsina Government Station. When this shaft is completed pumping tests are to be made over a period of several months and the behaviour of the water table observed in three narrow-diameter shafts which have been constructed in the neighbourhood of the main shaft.

Well sinking in Gumel Emirate, Kano Province, was suspended in July owing to lack of funds and the equipment was transferred to Hadejia Emirate, where work is now in progress. Operations were continued with great success in the Babura, Ringim and Garki Districts of Kano Emirate. In Bornu Province, work has been centred mainly in the west of Bornu Emirate and in Fika Emirate. Pressure rises were obtained in most shafts. Satisfactory results were again obtained in the Katagum Division of Bauchi Province, where steady progress has been made. Two wells were sunk in Bauchi Emirate and plans are in hand for the extension of the work to Misau Emirate.

This branch of the Department's activities was extended

to the Southern Provinces at the end of the year when a start was made on a programme of well-sinking in Owerri Province.

Success has attended drilling for water at Otta, in Abeokuta Province, where an output of 5,400 gallons per hour has been proved from an eight-inch borehole. Considerable time was spent in evolving a technique which would affect the salvaging of water from the very fine, even-grained, unconsolidated sand, penetrated by the drill. The technique has been achieved and success is confidently expected in the similar circumstances which are known to prevail over most of the sedimentary areas of Nigeria.

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PLANT AND ANIMAL PRODUCTS

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Quarrying and Crushing Methods and Costs at the Avon Mountain Trap Rock Quarry of the Atlas Sand, Gravel, and Stone Company, West Hartford, Connecticut. By J. S. Dunning. *Inform. Circ. No.* 6912, *U.S. Bur. Mines*. Pp. 7, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1936.)

Quarrying and Crushing Methods and Costs at the Plainville, Connecticut, Trap-rock Quarry of the New Haven Trap Rock Co., New Britain, Conn. By A. L. Worthen. *Inform. Circ. No.* 6920, *U.S. Bur. Mines.* Pp. 23, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1936.)

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The Mineral Constitution of Various Ceramic Clays. By R. E. Grim and R. H. Bray. *J. Amer. Ceram. Soc.*, 1936, **19**, 307-315.

The Precious Metals as Materials for Decorating Pottery and Glass. By W. P. Harmsworth. *Sands, Clays, and Min.*, 1936, **3**, No. 1, 49.

Surface and Underground Methods of Clay Mining. By E. J. Lintner. *Min. and Metall.*, 1936, **17**, 573-576. The general methods of clay mining as practised in the United States.

Mining and Grinding Methods and Costs at the Dennison Sewer Pipe Company's Clay Mine, Dennison, Ohio. By E. J. Lintner. *Inform. Circ. No.* 6921, *U.S. Bur. Mines.* Pp. 16, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1936.)

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The British By-Product Coking Industry in 1936. By G. E. Foxwell. *Iron Coal Tr. Rev.*, 1937, **134**, 97-100.

The Geology of the Sanquhar Coalfield and Adjacent Basin of Thornhill. By J. B. Simpson and J. E. Richey. *Mem. Geol. Surv., Scotland.* Pp. 97, 9½ × 6. (Edinburgh: H.M. Stationery Office, 1936.) Price 3*s*.

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Blair Athol Coalfield, Queensland. By J. H. Reid. *Queensld. Govt. Min. J.*, 1936, **37**, 339-342.

Die Steinkohle der Lunzer Schichten (Austria). *Montan. Rdsch.*, 1936, **28**, No. 21, p. 1.

Coal Mining in Belgium: Some Comparisons with British Methods. By J. E. Brown and E. H. Vallis. *Iron Coal Tr. Rev.*, 1936, **133**, 901-902. Abstract of a paper read before the North Staffordshire Branch of the National Association of Colliery Managers.

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The Rosebud Coal Field, Rosebud and Custer Counties, Montana. By W. G. Pierce. *Bull. No.* 847-*B*, *U.S. Geol. Surv.* Pp.43-120, 9×6, and maps. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1936.) Price $1.25.

Geology and Fuel Resources of the Southern Part of the San Juan Basin, New Mexico. Part 2: The Mount Taylor Coal Field. By C. B. Hunt. *Bull. No.* 860-*B*, *U.S. Geol. Surv.* Pp. 31-80, $9 \times 5\frac{3}{4}$, and maps. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1936.) Price $1.

Mining Methods used in the Grundy Coal Field of Buchanan County, Virginia. By A. L. Toenges and R. L. Anderson. *Inform. Circ. No.* 6928, *U.S. Bur. Mines.* Pp. 43, $10\frac{1}{2} \times 8$. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1936.)

Analysis of Chinese Fuels, with an Appendix of Analysis of Ores and Minerals. By K. Y. King and W. S. Hsia. *Bull. Geol. Surv. China*, 1936, No. 28, 33-40.

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Geologische Beobachtungen an Diamantlagerstätten der Goldküste, Westafrika. By G. Knetsch. *Z. prakt. Geol.*, 1936, **44,** 167-174.

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The Feldspar and Quartz Mining Industry in Canada, 1935. *Min. Metall. Chem. Br., Canada.* Pp. 10, $11 \times 8\frac{1}{2}$. (Ottawa: Department of Trade and Commerce, 1936.)

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Fluorspar in South Africa. By W. E. Sinclair. *Min. Mag., Lond.*, 1936, **55,** 265-270. An account of the revival of a small and little-known industry in the Union, with a description of the mode of occurrence of the fluorspar deposits and the methods of production.

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Canadian Graphite: a Review of the Industry. *Canad. Min. J.*, 1937, **58,** 12-13.

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Gypsum: the New Building Material. By E. F. Mactaggart. *Cement, Lime, and Grav.*, 1937, **11,** 60-61. 1. The history of gypsum as a building material.

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The Design and Operation of Modern Lime Works. By N. V. S. Knibbs. *Cement and Lime Manuf.*, 1937, **10,** 4-11. A discussion of the design of lime works and of the factors which influence their construction and operation.

The Lime Industry in Canada, 1935. *Min. Metall. Chem. Br., Canada.* Pp. 9, 11 × 8½. (Ottawa: Department of Trade and Commerce, 1936.)

Nitrates

Informe sobre los Yacimientos de Salitre de Siguas de la Provincia de Camaná. By E. Portaro. *Bol. No.* 113, *Cpo. Ing. Min., Peru.* Pp. 136, 9¾ × 7. (Lima: Ministerio de Fomento, 1935.)

Informe sobre la Exploración de los Yacimientos de Salitre de la Región del Oeste del Valle de Majes. By E. Portaro. *Bol. No.* 113 *A, Cpo. Ing. Min., Peru.* Pp. 20, 9¾ × 6¾. (Lima: Ministerio de Fomento, 1936.) Appéndice del Boletin No. 113.

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Die deutschen Rohöle und ihre Verarbeitung. By J. Weller. *Glückauf,* 1936, **72,** 1156-1160.

Roumanian Oilfield Conditions To-day. By L. V. W. Clark. *Petrol. Times,* 1936, **36,** 579-581.

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Oil Refining in the U.S.S.R.: a Survey of Recent Progress. By N. Efruni. *Petrol. Times,* 1937, **37,** 20-21.

Petroleum Engineering Report, Big Spring Field and Other Fields in West Texas and South-eastern New Mexico. By C. B. Carpenter and H. B. Hill. *Rep. Invest. No.* 3316, *U.S. Bur. Mines.* Pp. 223, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1936.)

Oil and Gas Development in Illinois in 1935. By A. H. Bell. *Press Bull. Ser. No.* 28, *Geol. Surv. Illinois.* Pp. 15, 10 × 6¾. (Urbana: Illinois State Geological Survey, 1936.) Reprinted from: *Trans. Amer. Inst. Min. Engrs.,* 1936, **118,** 238-250.

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Talco: a New Oil Field in North-eastern Texas. By P. Olcott. *Min. and Metall.,* 1936, **17,** 519-520.

Reconocimiento Geológico de los Yacimientos Petrolíferos del Departamento de Puno. By A. Cabrera la Rosa and G. Petersen. *Bol. No.* 115, *Cpo. Ing. Min., Dep. Petrol., Peru.* Pp. 100, 9¾ × 7. (Lima: Ministerio de Fomento, 1936.)

New Uruguayan Petroleum Installation: a Description of the New Refinery being erected by the Administracion Nacional de Combustibles Alcohol y Portland. *Petrol. Times*, 1936, **36**, 783-789.

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Superphosphate Manufacture: Recent Developments in its Technology. By W. G. T. Packard. *Chem. Tr. J.*, 1937, **100**, 69-71. Abstract of a paper read before the Institution of Chemical Engineers, London.

Tennessee Valley Authority estimates favourable Costs for Concentrated Superphosphate. By H. A. Curtis, A. M. Miller, and J. N. Junkins. *Chem. Metall. Engng.*, 1936, **43**, 583-587, 647-650. Report of an examination into the cost of producing concentrated superphosphate.

Talc

Flotation of Vermont Talc-Magnesite Ores. By J. B. Clemmer and S. R. B. Cooke. *Rep. Invest. No.* 3314, *U.S. Bur. Mines.* Pp. 12, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1936.)

NOTICES OF RECENT LITERATURE

Books for review should be addressed to "The Editor," Bulletin of the Imperial Institute, South Kensington, London, S.W.7.

English Farming, Past and Present. By the Right Hon. Lord Ernle, P.C., M.V.O. New Edition, edited by Sir A. D. Hall, K.C.B., M.A., F.R.S. Pp. xvi + 559, 8½ × 5½. (London, New York, Toronto: Longmans, Green & Co., Ltd., 1936.) Price 15*s*.

This is the fifth edition of Lord Ernle's well-known standard work, first published under its present title in 1912, and the new issue will be welcomed by a wide circle of readers. Sir Daniel Hall, who undertook the preparation of the new edition, points out in his Preface that "the post-war period has witnessed revolutionary changes in the practices of agriculture and in the attitude of the State, of which the student of agriculture might well desire some summary account"; and for this reason, he decided to modify certain sections in a suitable manner. Sir Daniel adds that he takes pride in being associated with a book from which he and his contemporaries "have learned to look upon English agriculture as something

continuously growing, whose present status and future development cannot be understood without an appreciation of its roots in the past."

THE ORGANISATION OF AGRICULTURE, WITH APPLICATIONS TO SOUTH AFRICA. By Hubert D. Leppan. Pp. iv + 83, 7 × 4¾. (Johannesburg: Central News Agency, Ltd., 1936.) Price 6s.

The author of this small volume, who is Professor of Agricultural Economics at Pretoria University, explains in the Preface that he has devoted "nearly half the discussion to the world situation and general aspects of the farming industry," in order to supply an adequate background for the subject which is his main purpose, viz. South African agriculture and the steps necessary to bring it into a more satisfactory state. The author's suggestions and arguments are clearly presented, and the book should form a useful aid to agricultural progress in the Union and the adjustment of the farming industry to meet present-day requirements.

OUR NATURAL RESOURCES AND THEIR CONSERVATION. Edited by A. E. Parkins and J. R. Whitaker. Pp. xii + 650, 9 × 6. (New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd., 1936.) Price 25s.

This work is a symposium by over twenty expert contributors, representing various universities and colleges in the United States. As the editors state, "conservation seeks to ensure to society the maximum benefits from the use of our natural resources," and the subject of the volume is clearly a matter concerning every highly organised country as well as the less settled regions which are being developed under civilised auspices. The articles in the present volume naturally deal mainly with conditions in the United States, but many of the subjects discussed and the modes of procedure put forward are worth the attention of agricultural, forestry and mining experts, surveyors, engineers and others in many parts of the British Empire, and the book can be strongly recommended to all concerned with the theory or practice of the conservation of economic resources. The volume, which is well provided with maps, diagrams and illustrations, is very practically arranged and eminently readable.

MANDATES: REASONS, RESULTS, REMEDIES. By Neil Macaulay. Pp. x + 213, 7½ × 5. (London: Methuen & Co., Ltd., 1937.) Price 6s.

This is an illuminating, as well as an entertainingly and clearly written book, setting out the terms and conditions

on which the Mandatory Powers hold and administer the former German colonies, and dealing with the reasons behind German claims for their return to the Reich and the manner in which such claims are put forward. Allowing for some expression of personal views on the part of the writer, it can be recommended to the general reader as a concise presentation of facts which are essential to a proper understanding of the question, and in particular, as worth careful study by those who advocate an alteration of the present arrangements.

A serious misprint occurs on page 173, where the proportion of Tanganyika's exports of sisal to the world total is given as "0·33 per cent." Reference to the original source shows that this should read "?33 per cent."

THE STUDY OF THE SOIL IN THE FIELD. By G. R. Clarke, B.Sc., M.A. Pp. 142, $6\frac{3}{4} \times 4\frac{3}{4}$. (Oxford: The Clarendon Press, 1936.) Price 5*s*.

The examination of soils in the field, as a subject of study apart from direct questions of agriculture, has been unduly neglected in the past, except perhaps in Russia. During recent years its importance is being increasingly recognised, not only from the purely scientific point of view, but also in relation to schemes of land classification and utilisation.

The requirements for such a study of the soil naturally vary in different countries. Soil surveys in Russia or America, for example, where there are large areas similar in geological origin and climatic conditions, cannot be conducted on the same lines as in this country, where many varieties of soil may be found in a comparatively small area. In all soil survey operations, however, the worker needs a considerable knowledge of natural science and above all, a faculty for accurate observation and for exact recording of his observations.

This little book aims at presenting the experience of the author and contemporary workers in the same field in such a way as to be of use to other scientific observers, to students, and also to those non-specialists to whom some knowledge of the soil is essential and who desire guidance as to what to look for and record.

The book opens with a short introduction on the value of field observations, followed by a long chapter on the determination of the characteristics of a soil from the information obtainable by examination of the site and the profile. Methods of describing a soil profile are given in considerable detail, together with a short description of soil sampling by means of the soil monolith, and an account of the use of field observations for the mapping of soils.

The final chapter gives an outline of various soil survey systems in use in different parts of the world, with notes on their relative value and difficulties.

The method adopted for giving references to original literature appears to be rather casual and far from uniform, as often only the author's name is mentioned. In view of the labour and expense involved in the digging of pits and the collection of monoliths, some information on other methods of taking soil samples (even if less satisfactory than the monolith) would have been useful.

The book as a whole, however, will undoubtedly prove useful to many who need to make some kind of systematic soil classification from observations in the field.

AN INTRODUCTION TO THE SCIENTIFIC STUDY OF THE SOIL. By Norman M. Comber, D.Sc., A.R.C.S., F.I.C. Pp. vii + 206, $7\frac{1}{4} \times 5$. Third Edition. (London: Edward Arnold & Co., 1936.) Price 7*s*. 6*d*.

The present edition of this book follows to a very large extent the same lines as the second edition previously noticed in this BULLETIN (1932, **30**, 527). Certain sections, such as those dealing with modern conceptions of humus, with the micro-biology of the soil, and with the mineralogy of clay, have been revised in view of recent work. Considerable alterations have also been made in the chapter dealing with the movement of water in soils, in order to include a short account of the most modern views of such subjects as capillary potential and *p*F values. No great changes have been made in the parts of the book dealing with the classification and genetics of soils, for although a large amount of work has been done on soil profiles, there have been no notable advances in the accepted fundamental principles.

The book should continue to fulfil in a satisfactory manner the objects which are implicit in the title.

COMPOSTING TEA ESTATE WASTES. By A. G. D. Bagot. Pp. xvi + 24, $7\frac{1}{4} \times 4\frac{3}{4}$. (Colombo and London: The Times of Ceylon Co., Ltd., 1936.) Price 6*s*. 3*d*.

The author of this little work is Superintendent of a tea estate in Ceylon and he records the results of experiments conducted there with a view to adapting the Indore process for the rapid humification of vegetable matter to suit tea estates. As Mr. F. K. Jackson, Director of the Institute of Plant Industry, Indore, says in his Foreword, " those planters who wish to try composting themselves now have at their disposal a reliable technique adjusted at least to Ceylon

conditions." Particulars are given regarding the various kinds of waste material on a tea estate that can be used for composting; the suggested methods of manufacturing the compost are described fully and the question of costs, mode of application and manurial value are also dealt with.

THE APPLES OF ENGLAND. By H. V. Taylor, O.B.E., B.Sc., A.R.C.Sc. Pp. 266, $9\frac{3}{4} \times 7\frac{1}{4}$. (London: Crosby Lockwood & Son, Ltd., 1936.) Price 21s.

PROFIT FROM FERTILIZERS. By H. V. Garner, A. H. Hoare, H. C. Long, R. G. Stapledon, F. Rayns, and T. Wallace. Pp. 176, $8\frac{1}{2} \times 5\frac{1}{2}$. (London: Crosby Lockwood & Son, Ltd., 1936.) Price 7s. 6d.

SHEEP FARMING. By Allan Fraser, B.Sc., M.D. Pp. 178, $8\frac{1}{2} \times 5\frac{1}{2}$. (London: Crosby Lockwood & Son, Ltd., 1937.) Price 7s. 6d.

These volumes are the first three of a new series of Agricultural and Horticultural Handbooks issued under the general editorship of Mr. H. C. Long.

Written by experts, and well illustrated, they can be thoroughly recommended to all interested in the subjects with which they deal.

Dr. Taylor's book differs both in format and scope from the others. It is concerned with the varieties of apple grown in England, and is divided into two parts. The first opens with a discussion of what is meant by a variety, traces the development of British varieties from the earliest times and passes on to describe the various tree, leaf, blossom and fruit characters, the transmission of hereditary characters through the agency of chromosomes, the uses of apples for dessert, culinary purposes and cider-making, and closes with a brief account of the classification of varieties. The second and larger part of the book is occupied by a description of the varieties arranged in alphabetical order. In the case of those in general cultivation, which form the greater part of those dealt with, an account is given of the origin of the variety, a description of the fruit characters, the time it is in season, and references to published illustrations. All the technical descriptions have been made from actual fruits handled by the author so that their reliability is unquestioned.

Profit from Fertilizers is not a detailed treatise on the different kinds of fertilizers, but its object is rather to prove to farmers that it pays to fertilize. Each chapter is contributed by a well-known authority. H. C. Long writes the introduction on the elements of plant nutrition and a chapter on compound and concentrated fertilizers and their

use. H. V. Garner, of Rothamsted, deals with the nutritional requirements of crops and contributes three appendixes on the distribution of fertilizers, their evaluation and composition. The chapters on the manuring of permanent and temporary grass and on hill pastures are by Professor R. G. Stapledon, of Aberystwyth; and that on the manuring of arable crops by F. Rayns, of the Norfolk Agricultural Station, Sprowston. The manuring of fruit crops is dealt with by Dr. T. Wallace, of Long Ashton; and that of market gardens and flower crops by A. H. Hoare, of the Ministry of Agriculture.

Although Dr. Fraser, the author of *Sheep Farming*, is Deputy Director for Research at the Duthie Experimental Stock Farm of the Rowett Institute, his book, as Sir John Orr points out in a Foreword, is written from the point of view of the field rather than the laboratory. He deals with all aspects of the industry, with the breeds of sheep, the rearing of the lambs, feeding the sheep, buying and selling, diseases and pests. The many beautiful pictures add to the charm of a book which is not only of value to sheep farmers and shepherds, but will be found of interest to all country lovers.

REPORT OF THE FOOD INVESTIGATION BOARD FOR THE YEAR 1935. Department of Scientific and Industrial Research. Pp. x + 232, 9½ × 6. (London: His Majesty's Stationery Office, 1936.) Price 3*s*. 6*d*.

This report gives a concise statement of the progress of the multifarious investigations conducted by members of the Board's staff and others during the year, each section being written by the officer responsible for the research concerned. Most of the work is concerned with the problems which arise in the handling and storage of perishable foodstuffs, such as meat, fish, bacon, eggs, fruit and vegetables. The results therefore have a direct bearing on everyday practical things. The importance of close contact with the trade in these matters is recognised by the Board, who have decided to establish in the vicinity of Smithfield Market a laboratory for meat investigation on the lines of the Covent Garden Laboratory, where so much good work has been carried out on fruit and vegetables.

The wide range of the work in progress can be gauged from the following list of subjects selected almost at random from those summarised in the Report: Physiology of Muscle Proteins, Anti-oxidants and the Preservation of Edible Fats; The Commercial Storage of Eggs; Quality in the Pig's Carcass, The Action of Salts used in the Curing of Bacon on Bacteria; The Freezing and Cold-storage of Fish, The Salt-curing of

Herring; The Cold Storage and The Gas Storage of English-grown Pears, The Respiration and Ripening of Bananas, Wraps for the Prevention of Rotting of Fruit, The Respiration and Water-content of Seeds, The Storage and Freezing of Vegetables; The Corrosion of Tin and Aluminium, The Storage of Soft Fruits for Subsequent Canning, The Concentration of Passion-fruit Juice by Freezing; The Package in Relation to the Transfer of Heat and to Humidity, The Production of Low-temperature Brine, Resistance Thermometry on Board Ship.

PERFUMES, COSMETICS AND SOAPS. By William A. Poucher, Ph.C. Volume II. Being a Treatise on the Production, Manufacture and Application of Perfumes of all Types. Pp. xiii + 426, $8\frac{1}{4} \times 5\frac{1}{2}$. Fifth Edition. Volume III. Being a Treatise on Modern Cosmetics. Pp. xi + 228, $8\frac{1}{4} \times 5\frac{1}{4}$. Fifth Edition. (London: Chapman & Hall, Ltd., 1936.) Price Vol. II, 25*s.*, Vol. III, 21*s.*

Volume I of the present edition, which describes the raw materials of perfumery, was reviewed in this BULLETIN (1936, **34**, 302), and notices of previous editions in earlier volumes (1932, **21**, 665; 1926, **24**, 74). Volume II of the previous editions, which dealt with the essentially practical aspects of the subject, is now divided into two parts, Volume II being devoted to Perfumes, and Volume III to Cosmetics. The general arrangement remains the same, but the subject matter has been carefully revised and generally brought up to date. The section dealing with Perfumes contains four new chapters (flower absolutes, odour classification, sachets and fruit flavours), and has increased in size by the addition of about 150 more pages, and a further 28 illustrations, making 83 altogether. As in the past a special feature of this section is the flower monographs which contain much new material; the one on the rose being especially valuable.

The volume on Cosmetics contains three new chapters, dealing with hair dyes, rouges and eye cosmetics, and sunburn preparations, and the text has been increased by the addition of 96 pages.

This authoritative work will still prove indispensable to all interested in the perfumery and cosmetic industry, and will continue to enjoy the wide circulation it deserves.

PRACTICAL PHARMACOGNOSY. By T. E. Wallis, B.Sc., F.I.C., Ph.C., F.L.S. Pp. viii + 226, $8\frac{3}{4} \times 5\frac{1}{2}$. Third Edition. (London: J. and A. Churchill, Ltd., 1936.) Price 12*s.* 6*d.*

This book is intended primarily as a guide to the student in his practical work, giving schedules of instruction for the

examination of pharmaceutical materials, though the wealth of information contained in the notes and the numerous illustrations should earn it a far wider field of utility. Particularly useful from a practical standpoint are the tables of histological characters for the recognition of plant materials used in pharmacy.

The book is divided into five parts dealing with the general examination of drugs, plans for drug description, histological examination, quantitative analysis and the examination of drugs in powdered form. It concludes with an appendix giving the composition of reagents used in the practical work and a six-page index.

A Preliminary Survey of the Forest Types of India and Burma. By H. G. Champion. Indian Forest Records (New Series), Vol. I, Silviculture, No. 1. Pp. x + 286 + viii, $9\frac{3}{4} \times 7\frac{1}{2}$. (Delhi: Manager of Publications, 1936.) Price 17*s*. 6*d*.

As a "preliminary Survey" this book is very comprehensive, and besides stimulating further work on the Indian forest types it will prove of immediate value to the silviculturist, especially in connection with forest management under working plans, where a standard classification has been badly needed.

The work is based largely on Mr. Champion's own observations and field notes, over a period of twenty years, supplemented by information collected by silviculturists in different Provinces specially for the purpose. Full use, of course, has also been made of published work on the subject.

The book opens with a short discussion of climatic and other factors which determine the forest types, and reference is made to the difficulty of framing a classification of climates which is in agreement with the distribution of vegetation.

In this survey four primary zones, based on temperature, are recognised, and these are subdivided on a moisture basis, as indicated in the vegetation itself by the relative proportions of evergreen, deciduous and thorny trees. Some of these classes are further divided into northern and southern variations, each consisting of a group of forest types. Besides the climatic climax types certain of the more important edaphic and seral types are listed.

For each type a general description is given of the forest, its distribution, locality factors and floristics, and, where possible, ecological associations within the type are indicated. Edaphic variants and general successional relationships are also discussed.

The book contains photographs of a number of the types described and references are given to published illustrations

of others; there are in addition two maps, one showing the distribution of climatic types in India and the other average annual rainfall. It concludes with a list of types occurring in each province, a bibliography and index.

CHECK-LISTS OF THE FOREST TREES AND SHRUBS OF THE BRITISH EMPIRE. Edited by J. Burtt Davy, M.A., Ph.D. and A. C. Hoyle, M.A., B.Sc. No. 2 NYASALAND PROTECTORATE. Compiled by the Imperial Forestry Institute in collaboration with the Forest Department of Nyasaland. Pp. 111, 8½ × 5½. (Oxford: Imperial Forestry Institute, 1936.)

This list, like the first of the series, which dealt with the trees and shrubs of Uganda, is drawn up with full regard to practical needs of field-use, reference being facilitated by the arrangement of the families in alphabetical order. An additional feature is the excellent description of Nyasaland forest-types written by Mr. P. Topham, Assistant Conservator of Forests in the Protectorate. Collectors' numbers and the brief notes on the character of the plants which were given in the text of the Uganda check-list have here been omitted owing to lack of space. Although doubtless some readers will regret the absence of the notes, their needs have been met to some extent by indicating the common species, evergreens, useful timbers and plants used in native medicines by means of symbols. The thorough treatment of native names in the text and index is a great asset. A list of exotics and an index to genera complete this useful volume, and it is to be hoped further numbers of the series will not be long delayed.

A HANDBOOK OF HOME-GROWN TIMBERS. Department of Scientific and Industrial Research, Forest Products Laboratory. Pp. iv + 47, 9½ × 6. (London: His Majesty's Stationery Office, 1936.) Price 1s. 6*d*.

Although a revised edition of a publication entitled *The Uses of Home-grown Timbers*, which first appeared in 1927, the present book is differently arranged and contains a great deal more valuable information. Apart from a brief introductory note the entire book is taken up with the descriptions of different timbers, which include twenty-four species of hardwoods and seven species of softwoods. In each case an account of the working qualities and uses of the wood is given and, in addition, a general description of the tree and its timber and brief notes on seasoning and mechanical properties, durability, resistance to insect attack and preservative treatment.

TYPES OF TIMBER KILNS. By R. G. Bateson, B.A. *Department of Scientific and Industrial Research, Forest Products Research Records No.* 13, *Seasoning Series No.* 3. Pp. 9, $9\frac{3}{4} \times 6$. (London: His Majesty's Stationery Office, 1936.) Price 6*d*.

This booklet aims at giving information which will assist timber merchants or manufacturers in choosing a kiln for any particular purpose. The principal types of both natural draught and forced draught kilns are concisely described with the aid of diagrams, and their merits and disadvantages for different purposes are discussed. A section giving dimensions and capacities of typical kilns of various types concludes this most useful publication.

ILLUSTRATED POLYGLOTTIC DICTIONARY OF PLANT NAMES. By Armenag K. Bedevian, Dip.H.A.(Giza), with a preface by W. Lawrence Balls, M.A., Sc.D., F.R.S. Pp. xvi + 1100 + xii, $7\frac{3}{4} \times 5\frac{1}{2}$. (Egypt: A. K. Bedevian, Botanical Section, Giza (Branch), 1936.) Price 20*s*. 6*d*.

This dictionary, in the words of Dr. Balls, is " a conscientious and trustworthy attempt to co-ordinate botanical usage in the Eastern Mediterranean countries." It does not claim to deal with all the plants that the worker in the Levant is likely to come in contact with, but includes all cultivated crops, fruit trees and vegetables, industrial, medicinal and poisonous plants, the more important and attractive ornamental plants and garden flowers, and the more common weeds of the farm.

The dictionary is in two parts, arranged so that plants may be traced from their common names in any of the seven languages treated. In Part I they are arranged alphabetically under the botanical names and assigned serial numbers. With each species the important synonyms are cited and the vernacular names given in English, French, German, Italian, Turkish, Armenian and Arabic (both transliterated and in Arabic characters). The natural order is given and in the majority of cases small line drawings are included as a guide in identification. Part II consists of indexes in the seven different languages, including a separate treatment of original and transliterated Arabic. These are printed on different coloured papers and refer one to the serial numbers in Part I where all the names are given together. Notes are included on the pronunciation of Latin, Arabic, Armenian and Turkish names and on the alphabets of the last three of these. The book must represent an enormous amount of work and Mr. Bedevian is to be congratulated on reproducing the information in so compact and useful a form.

ENGINEERING GEOLOGY. By H. Ries, Ph.D., and Thomas L. Watson, Ph.D. Fifth Edition. Pp. vii + 750, 9 × 6. (New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd., 1936.) Price 25*s*.

The small amount of major alteration found to be necessary after five years in its fourth edition, is a tribute to the useful form and contents of this text-book for the civil engineer. The large number of references have been brought up to date, and many of the chapters have been improved and new illustrations added, but the book remains substantially the same. There are 222 pages dealing with minerals and rocks, 224 pages on the natural forces to which they are subject, and 97 on the production of structural materials. The remaining 150 pages cover the geology of coal, petroleum and metallic ore deposits, road materials and construction, and historical geology.

Though the viewpoint and illustrations are mainly American the book cannot fail to be useful to civil engineers in all parts of the world.

CONGRÈS INTERNATIONAL DES MINES, DE LA MÉTALLURGIE ET DE LA GÉOLOGIE APPLIQUÉE. VII^e Session, Paris, 20-26 Octobre, 1935. SECTION DE GÉOLOGIE APPLIQUÉE. Tome I, pp. 1-528; Tome II, pp. 529-1088, 11 × 8. (13, Rue de Bourgogne, Paris, VII^e.) Price 120 Francs, the two volumes.

These two voluminous publications contain the full text of the papers presented to the section of practical geology at the international congress held in Paris in 1935. All the papers appear in French but the authors are by no means restricted to French nationality. Barely half a dozen English geologists contribute and most of these are serving on the West African Geological Surveys.

There are 127 papers in the 1088 pages, so that most of the contributions are of necessity rather brief. The arrangement of the papers is according to subject under the following headings, the numbers in brackets corresponding to the number of papers under each heading: Volume I. Deposits of magmatic origin (24), deposits of sedimentary origin (17), petroleum (19). Volume II. Geology and civil engineering (5), geology applied to agriculture (5), water supply (26), geophysics (10), teaching and research institutions (15), applied geology in Mozambique (6).

The volumes are well illustrated with sketch maps, line diagrams, half-tone blocks, and numerous plates.

TITANWEISS. By Dr. -Ing. Kurt Heise. Pp. 96, $8\frac{3}{4} \times 6$. (Dresden and Leipzig: Verlag von Theodor Steinkopff, 1936.) Price RM. 6.

In spite of the fact that the commercial manufacture of titanium white pigments began twenty years ago in Norway, this little book appears to be the first comprehensive publication on the subject. Hitherto the information available has been mainly contained in numerous scattered journal articles and patent specifications.

After four pages of introduction covering the history of titanium pigment manufacture in the producing countries, the subject matter of the book is comprised in three chapters which deal respectively with production processes, utilisation and properties, and methods of examination and specifications.

In the first chapter a few pages are devoted to the occurrence, properties and concentration of the principal titanium minerals, but this section leaves much to be desired, and the prices quoted, which have been taken from very old sources, are of no practical value. The main part of the chapter, however, gives a brief sketch of the various processes which are in use or have been patented for manufacturing the white pigment. It contains classified lists of several hundred of the more important patents.

The second chapter gives a very useful summary of the uses and properties of the various kinds of titanium pigments on the market, the subject being dealt with under two headings—paints and other industries. Under the latter are included their use in lacquers of various kinds, plastic compositions, cosmetics, paper, linoleum, rubber, ceramic glazes and enamels, in the delustreing of silk and for certain catalytic purposes. The chapter also includes a list of the names of the various brands of titanium pigments manufactured or on sale in Germany together with the composition of each.

The third chapter deals with physical properties such as colour, brightness, grain size, covering power, hiding power, oil absorption and resistance to light and exposure to the weather, and with chemical properties and specifications.

A brief appendix on the chemistry of titanium concludes the volume.

While the information contained in this book will be mainly of interest to chemists, it may also be useful to consumers of titanium white, as it will aid them in choosing the type of product most suitable for their particular requirements. It does not purport to be an exhaustive treatise, but rather to provide a brief summary of the subject in all its aspects, and for those who desire more detail a large number of bibliographical references are provided.

TUNGSTEN: A TREATISE ON ITS METALLURGY, PROPERTIES AND APPLICATIONS. By Colin J. Smithells, M.C., D.Sc. Pp. viii + 272, 9½ × 6. Second Edition, Revised. (London: Chapman & Hall, Ltd., 1936.) Price 25*s*.

The first edition of this well-known book was published ten years ago, since when the large increase both in our knowledge of the properties of the metal and in its industrial applications has necessitated the size of the present volume being nearly twice that of its predecessor.

Dr. Smithells is a member of the research staff of the General Electric Company, and it is perhaps natural that he should give prominence in his book to the manufacture and utilisation of pure ductile tungsten, but the undue prominence given to this aspect in the first edition has been largely rectified in the second edition by the inclusion of much new matter. As the author remarks in his preface, the field has become so large that it is no longer easy to maintain direct contact with all the industrial applications of the metal, and he has therefore partly assumed the rôle of editor. A chapter on the Alloys of Iron and Tungsten, and the Tungsten Steels has been contributed by J. H. G. Monypenny, Chief of the Research Laboratory of Brown, Bayley's Steel Works; one on Thermionic Emission is by Dr. A. L. Reimann, of the General Electric Company, and another by T. R. Bird deals with the Hard Alloys of Tungsten Carbide. There is also a new chapter on the Non-Ferrous Alloys.

In general the subject matter has been carefully revised and brought up to date, but it is unfortunate that the account of the world production of tungsten minerals given in Chapter I contains some incorrect statements. Some of these are due to lack of revision, but the assertion on p. 2 that Australia "still produces most of the scheelite on the market," was already out of date in 1926. Statistics show that for the three years 1933-1935 the Federated Malay States produced 3,791 tons of scheelite, and Australia 11 tons. The fact that the Federated Malay States produce scheelite is not mentioned.

This second edition is much more comprehensive than the first and constitutes a valuable book of reference which should be a standard work for some considerable time. The book is clearly written and easily readable throughout. The standard of the printing, the numerous plates, and of the publication as a whole is excellent.

PRACTICAL CLAYWORKING. By Arthur E. Brown, B.Sc. Pp. 241, 8½ × 5½. (London: The Clayworker Press, 1936.) Price 7*s*. 6*d*.

This book should prove a valuable addition to the ceramist's library.

It deals with the practical handling of plant in the brick and tile branches of the industry, and is unique in that it is devoid of illustrations. Raw materials, fuel, sources of power, transport, hand and machine moulding, drying, setting and burning are all adequately described in a manner calculated to be of real interest to the practical man and the technical consultant.

The book can be thoroughly recommended to all who desire an accurate and concise work on brick and tile making, at a reasonable price.

SEMI-MICRO QUALITATIVE ANALYSIS. By Carl J. Engelder, Ph.D., Tobias H. Dunkelberger, B.S., and William J. Schiller, Ph.D. Pp. x + 265, 9 × 6. (New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd., 1936.) Price 13*s*. 6*d*.

The authors of this book have been teaching in the University of Pittsburgh since 1931 a system of qualitative analysis based on the use of "drop" reactions. The experience so gained has enabled them to compile a text-book of semi-micro qualitative analysis which is sufficiently detailed to be used by the student starting the subject and wide enough in its scope to interest the experienced analyst.

The book opens with a few chapters dealing briefly with the theory of qualitative analysis. The reactions of the individual metals and acid radicals are then described together with a systematic scheme for their detection in mixtures. While the old grouping of the metals has been retained, the confirmatory tests, of which a large number are given, are, in many cases, more modern colour or "spot" tests. Those which the authors have tried and found successful are described in detail, and brief reference is made to many more. In most cases references to the original literature are included, and where the journal concerned is not easily obtained, the corresponding reference to *Chemical Abstracts* is added.

In the scheme for complete analysis it is directed that about two milligrams of material should be taken and solutions having a volume of about one millilitre used for the group separations, the confirmatory tests being then carried out on drops of solution. In this way separations can be carried out in small centrifuge tubes, and the use of the microscope for the identification of characteristic crystals is avoided. The necessary equipment is thus very simple.

The technique of analytical chemistry has been considerably amplified in recent years by the growing popularity, amongst other developments, of micro methods of analysis,

and this book, which is a very useful addition to the literature of this branch, will be of interest both to the advanced student and to the progressive analyst.

PRINCIPLES AND APPLICATIONS OF ELECTROCHEMISTRY, Vol. I, PRINCIPLES. By H. Jermain Creighton. Pp. xviii + 502, 9 × 6. Third edition, Revised and Enlarged. (New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd., 1935.) Price 25*s.*

This is the third edition of a textbook which was first published in 1924. The considerable demand for the book and the many recent advances in theoretical electrochemistry have necessitated a revision of the older text and the inclusion of new subject matter.

The author has adopted a wide interpretation of his subject. Commencing with first principles he describes the whole field of theoretical electrochemistry in some detail, and includes a consideration of modern theories of strong electrolytes and the electrochemistry of gases.

This volume, which includes a full list of references and a series of problems at the end of each chapter, is mainly intended for advanced students, to whom it can be recommended, but the industrial or research chemist who occasionally meets a problem involving a particular knowledge of electrochemistry will find it a useful reference book.

BOOKS RECEIVED FOR NOTICE

THE SOUTH AND EAST AFRICAN YEAR BOOK AND GUIDE FOR 1937, with Atlas and Diagrams. Edited annually by G. Gordon Brown, F.R.G.S., for the Union-Castle Mail Steamship Co., Ltd. Pp. lxvi+1129, 7×5. (London: Sampson Low, Marston & Co., Ltd., 1936.) Price 2*s.* 6*d.*

THE PRODUCTION OF FIELD CROPS. By T. B. Hutcheson, T. K. Wolfe and M. S. Kipps. Pp. xvii+445, 9×6. Second Edition. (London: McGraw-Hill Publishing Co., Ltd., 1936.) Price 21*s.*

1935 BIBLIOGRAPHY OF RUBBER LITERATURE (Excluding Patents). Compiled by Donald E. Cable, Ph.D. Pp. 130, 9×6. (New York: The Rubber Age, 1936.) Price $1.00.

THE EVOLUTION OF THE AUSTRALIAN MERINO. By E. W. Cox. Pp. xxii+160, 10×7. (Sydney and London: Angus & Robertson, Ltd., 1936.) Price 21*s*.

CORROSION RESISTANCE OF METALS AND ALLOYS. By Robert J. McKay and Robert Worthington. Pp. 492, 9×6. (New York: Reinhold Publishing Corporation; London: Chapman & Hall, Ltd., 1936.) Price 35*s*.

A PRACTICAL COURSE IN AGRICULTURAL CHEMISTRY. By Frank Knowles, F.I.C., and J. Elphin Watkin, B.Sc., Ph.D., A.I.C. Pp. ix+188, 8½×5½. (London: Macmillan & Co., Ltd., 1937.) Price 10*s*.

LABORATORY METHODS OF ORGANIC CHEMISTRY. By L. Gattermann, completely revised by Heirrich Wieland. Translated from the Twenty-fourth German Edition by W. McCartney, Ph.D., A.I.C. Pp. xvi+435, 8¾×5¾. (London: Macmillan & Co., Ltd., 1937.) Price 18*s*.

BULLETIN
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REPORTS OF RECENT INVESTIGATIONS AT THE IMPERIAL INSTITUTE

Selected from the Reports made to the Dominion, Indian, and Colonial Governments

TUNG SEED AND OIL FROM EMPIRE SOURCES. III

CONSIDERABLE interest continues to be taken in the cultivation of tung oil trees in countries of the Empire. New experimental areas have been planted, and some of the earlier plantings are yielding small crops of fruit. Many samples of fruits, nuts, and oil produced in the course of these experiments have been received at the Imperial Institute, either direct, or through the Royal Botanic Gardens, Kew, and the results of examination of some of these have already been published in this BULLETIN, 1932, **30**, 271; 1933, **31**, 327. In the present series of reports samples of both *Aleurites Fordii* and *A. montana* from various Empire countries are dealt with; samples of *A. Fordii* fruits from the Argentine and the United States are also included for comparison.

For convenience of reference the characters of the fruits, nuts, and kernels of the various samples and the results of examination of the oil are collected together in Tables I-IV. As in the case of previous samples, the Imperial Institute is indebted to Dr. L. A. Jordan, Director of the Research Association of British Paint, Colour, and Varnish Manufacturers, and a member of the Imperial Institute Sub-Committee on Tung Oil, for the examination of a large number of the samples.

ALEURITES FORDII

Assam

No. 1.—This sample, which was received in January 1935, consisted of fruits collected from 4½-year-old trees grown on a tea estate. They were slightly above average in size, but contained the normal number of kernels, and the overall oil content had about the usual value.

The oil obtained by cold expression was a trifle more acid than is usually found in *A. Fordii*, but the colour was good, suggesting that the acidity was not due to any decomposition in storage. The acidity was not sufficient, however, to be regarded as detrimental to the quality of the oil.

Burma

No. 2.—A sample of nuts, grown on the experimental tung plantation, Taunggyi, Southern Shan States, was forwarded by the Forest Economist, Burma, in January 1934. The results of their examination showed that they contained a normal percentage of oil. The oil, however, did not possess the characteristics of *A. Fordii* oil, but resembled much more closely the oil from the allied species *A. montana*. There was no evidence to show that the sample was a mixed one, and there seemed to be a possibility that the apparent abnormality of the oil might be due to the nuts having been obtained from immature trees. In order to determine whether this abnormality persisted in subsequent years, it was suggested that samples from the next year's crop should be furnished, and the following two samples were accordingly forwarded in January 1935.

Nos. 3a and 3b.—Samples of fruits (3*a*) and nuts (3*b*) stated to have been collected from the same trees which yielded the previous sample (No. 2).

Both samples contained a normal percentage of oil which corresponded more closely to the usual characters of *A. Fordii* oil than did the previous sample, although they still tended a little towards the lower values of *A. montana*. The results, however, seem to confirm the assumption that the material forwarded in January 1935 had been collected from immature trees.

It was noticed that the oil derived from kernels extracted from the fruits was of a paler colour and lower acidity than that from the nuts, and this affords an interesting demonstration of the effect of retaining the fruit in the whole state on the preservation of the oil.

South Africa

Nos. 4a and 4b.—Two sample of fruits, No. 4*a* grown in the White River district and No. 4*b* at Pilgrim's Rest, in the Transvaal, were received at the Imperial Institute towards the end of 1935.

The kernels from both samples gave on extraction oils which were very similar in character and of excellent quality. Further, the oil content when expressed on the entire fruits was higher than has been found in samples from China and America, which have been examined at the Imperial Institute.

Nos. 5 *and* 6.—A sample of nuts (No. 5), grown at Tzaneen, Northern Transvaal, was forwarded in June 1935, and a further sample (No. 6), consisting of whole fruits, was forwarded in June of the following year.

The kernels contained normal percentages of oil, the characteristics of which satisfied the requirements of the British Standard Specification for Tung Oil.

No. 7.—This consisted of fruits grown on the High Veld, about five miles north of Johannesburg, in the Transvaal, and was forwarded in September 1936. They were stated to have been grown from seed distributed from Kew in 1929.

The yield and the constants of oil were normal, but the time taken to form a gel was longer than is usually the case with good quality *A. Fordii* oil. The percentage of unpolymerisable matter was also higher. It is considered that this may be due to the immaturity of the fruits or to their being part of the first crop borne by the trees.

No. 8.—A sample of fruits grown near Cramond, Natal, was received at the Imperial Institute in September 1936. They were larger than is usual with *A. Fordii*, but the proportion of nuts was rather below the average. The percentage of kernels in the nuts, however, was high, and the oil content was very satisfactory, irrespective of whether it was expressed on the fruits, nuts, or kernels.

The oil was very similar in quality to that from sample

No. 7 and suffered the same drawbacks as regards the time of gelation and the percentage of unpolymerisable matter. These fruits, as in the case of that sample, were taken from the first crop borne by the trees.

No. 9.—A sample of nuts, collected from trees growing at Port Durnford plantation in Zululand, was forwarded in June 1933 by the Principal Botanist, Division of Plant Industry, Pretoria. He asked that the nuts might be examined in comparison with the samples of fruits grown at Bushbuck Ridge, near Pilgrim's Rest, Transvaal, and reported on by the Imperial Institute in November 1930 and November 1931 (see this BULLETIN, 1932, **30**, 276).

The nuts were satisfactory both as regards the yield and quality of the oil, but were smaller than those from the Transvaal fruits. The kernels were richer in oil than the earlier Transvaal sample, but contained less than the kernels from that received in 1931. It should be pointed out that the Zululand nuts were collected from several trees in a plantation, whereas the Transvaal fruit was obtained from one tree only.

Nos. 10*a and* 10*b*.—These samples were forwarded to the Imperial Institute in July 1935 by the Agricultural Officer, Mbabane, Swaziland. No. 10*a* consisted of fruits from a single-fruiting type of tree in its fifth year, while No. 10*b* consisted of fruits from a heavy-bearing multiple-cluster type of tree of the same age.

The fruits from the single-fruit tree were nearly double the weight of those from the other variety, but contained slightly less oil (expressed on the entire fruit), owing to the fruits containing a higher percentage of husk. The oils yielded were both of excellent quality.

Southern Rhodesia

Nos. 11*a and* 11*b*.—Two samples of fruits, No. 11*a* from a 6 to 7-year-old tree growing on poor slate soil, and No. 11*b* from a 6-year-old tree growing on a deep red fertile loam of dolorite origin, were forwarded by the Chief Forest Officer at Salisbury in June and August 1933. In each case the size of the fruits and the nuts was smaller than the average for *A. Fordii*.

The oils expressed from the kernels were very similar, and comparable with the commercial article.

Kenya

No. 12.—This sample of fruits from Kenya was received at the Imperial Institute in January 1936 and on examination proved to be of normal composition, yielding an oil of satisfactory characteristics.

Nyasaland

Nos. 13*a*, 13*b*, 13*c*, *and* 13*d*.—Four samples of fruits were forwarded to the Imperial Institute in June 1933. They had been furnished by the Conservator of Forests for examination in continuation of an investigation in 1932 of a sample of fruits from trees growing in the Kanjedza Forest Reserve (see this BULLETIN, 1932, **30**, 278). Two of the present samples (13*a* and 13*b*) consisted of fruits from the same Reserve, and samples 13*c* and 13*d* were from trees which had not previously fruited in the Zomba Mountain Forest Reserve and the Dedza Mountain Forest Reserve respectively.

The fruits of sample No. 13*b* were abnormally large. The four samples all yielded satisfactory quantities of oils, which were of excellent quality.

Cyprus

No. 14.—This sample of fruits was received in November 1935 from the Director of Agriculture, Cyprus.

They were of normal composition and the oil content of the kernels was quite satisfactory. The quality of the oil was excellent.

Australia

Nos. 15*a and* 15*b*.—Two samples of nuts, No. 15*a*, collected from trees grown on the alluvial lands near the Johnstone River, Queensland, and No. 15*b* from trees grown on red upland soils in the same valley, were received at the Imperial Institute in November 1933.

The nuts were of normal size, and the kernels from both samples yielded a satisfactory quantity of oil. The oil in each case was of excellent quality and the characteristics were very similar.

Foreign Countries

No. 16.—This consisted of a large sample of fruits obtained in December 1933 by drawing and mixing small samples taken at random from a number of bags of a shipment of fruits

grown on the Argentine plantations of Messrs. Liebig's Extract of Meat Co. at Misiones. The weight of the fruits and the number and size of the individual nuts were appreciably above the average. The oil content was satisfactory and the quality good. The results of examination of a previous sample of fruits grown on the same plantations is given in this BULLETIN, 1933, **31**, 333.

No. 17.—This sample of fruit was drawn from a consignment of 10 tons purchased in February 1934 by the Imperial Institute from the American Tung Oil Corporation in connection with crushing and decortication trials.

The fruits were normal as regards size and composition and the oil yielded agreed in its properties with that usually obtained from fruits grown in the United States.

TABLE I

ALEURITES FORDII

Characters of Fruits, Nuts and Kernels

Sample No.	Whole Fruit.					Nut.				Kernel.			
	Average weight in grams.	Percentage Husk.	Percentage Nut.	Average No. of Nuts.	Oil in Whole Fruit as received.	Average weight in grams.	Percentage Shell.	Percentage Kernel.	Percentage of Oil in Nuts as received.	Average weight in grams.	Percentage Moisture.	Oil in Kernels as received, *per cent.*	Oil in moisture-free Kernels, *per cent.*
1	28·32	52·7	47·3	3·35	16·3	3·975	40·8	59·2			1·51	58·3	59·3
2						3·33	44·3	55·7	31·3		5·2	56·2	59·2
3a	28·77	49·2	50·8	4·05	16·8	3·6	42·5	57·5			1·23	57·6	58·2
3b						3·11	41·1	58·9	34·8		1·65	59·0	60·0
4a	29·3	50·2	49·8	4·4	20·4	3·3	35·3	64·7	41·0	2·1	4·6	63·3	64·6
4b	32·0	49·0	51·0	4·7	21·1	3·5	36·1	63·9	41·3	2·2	4·4	66·4	67·6
5						3·4	36·3	63·7	39·3		4·9	61·7	64·8
6	32·9	51·3	48·7	4·8	19·7	3·4	33·5	66·5	40·4	2·2	5·3	60·7	64·1
7	20·4	44·2	55·8	4·1	19·7	2·8	38·5	61·5	35·3	1·8	5·8	57·4	60·9
8	43·8	53·5	46·5	4·6	18·7	4·4	35·6	64·4	40·1	2·9	4·8	62·3	65·5
9						3·2	37·1	62·9			4·1	55·1	57·3
10a	48·4	55·6	44·4	4·8	17·1	4·5	33·9	66·1	38·5	3·0	5·3	58·2	61·5
10b	27·4	49·3	50·7	4·3	19·5	3·2	34·7	65·3	38·5	2·1	5·3	59·0	62·3
11a	18·7	44·2	55·8	4·63	16·9	2·25	41·5	58·5			4·9	51·8	54·4
11b	23·7	57·4	42·6	4·85	14·1	2·09	41·6	58·4			4·6	56·8	59·6
12	24·6	51·9	48·1	4·3	18·2	2·8	36·4	63·6	37·9	1·8	4·7	59·6	62·5
13a	28·4	58·1	41·9	3·22	14·7	3·7	38·2	61·8			4·6	57·0	59·7
13b	35·66	49·7	50·3	4·23	16·8	4·24	36·6	63·4			4·9	52·5	55·2
13c	24·3	48·3	51·7	4·13	15·5	3·05	43·9	56·1			5·3	53·5	56·5
13d	25·9	46·8	53·2	4·1	17·2	3·35	41·0	59·0			4·4	54·9	57·4
14	28·4	45·4	54·6	4·6	21·2	3·3	37·6	62·4	38·8	2·1	4·8	62·2	65·3
15a						3·5	34·8	65·2	34·6		5·0	53·0	55·7
15b						3·4	35·5	64·5	34·3		4·6	53·2	55·7
16	34·8	46·3	53·7	4·7	18·9	4·0	37·2	62·8			5·6	56·2	59·5
17	29·1	46·8	53·2	4·73	18·0	3·27	37·8	62·2	33·9		3·9	54·5	56·7

TABLE II
Aleurites Fordii
Characters of Oil

Sample Number.	Colour. Lovibond cell. 10 mm. Red.	Colour. Lovibond cell. 10 mm. Yellow.	Colour. Lovibond cell. 1 in. Red.	Colour. Lovibond cell. 1 in. Yellow.	Colour. Paint Res. Sta. Scale.	Refractive Index. $n_D 25°C.$	Refractive Index. $n_D 20°C.$	Specific Gravity. at 25°C.	Specific Gravity. at 15.5° C.	Acid Value.	Saponification Value.	Iodine Value, Wijs, *per cent.*	Unsaponifiable Matter, *per cent.*	Heat Test. Brit. Stand. Spec. Method, mins.	Heat Test. Paint Res. Sta. Method, mins.	Heat Test. Extractive matter (unpolymerisable), *per cent.*
1	0·02	1·2	0·22	3·0	2	1·5170		0·9339		1·85		163·05			9·75	20·4
2	1·0	6·8	1·4	21·4	5	1·5143	1·5163	0·9343		2·82		162·4			11·75	29·1
3a	0·01	1·6	0·24	5·6	3	1·5170		0·9342		0·81		166·7			10·25	19·3
3b	0·24	1·5	0·50	4·7	3	1·5175		0·9341		1·11		163·75			10·5	21·0
4a			0·8	4·0			1·5208		0·9424	0·7		167·4	0·4	14·0	10·0	16·7
4b			0·6	3·0			1·5213		0·9422	0·3		168·6	0·4	13·5	10·0	16·3
5			1·05	7·0	2·5	1·5183		0·9339		0·27		169·0			8·5	18·6
6			0·4	2·5			1·5205		0·9413	0·4	193·7	164·1	0·3	14·5	8·5	17·5
7			1·4	13·0			1·5178		0·9428	0·5		164·8		17·5	11·0	27·5
8			0·6	2·5			1·5180		0·9405	0·3	191·8	168·1	0·4	16·5	10·75	23·0
9	0·24	0·68	0·5	1·9		1·5190		0·9358		0·39		172·9			9·25	18·5
10a			0·2	2·0			1·5207		0·9412	0·5	194·0	168·3	0·6	13·5	9·0	18·0
10b			0·2	2·0			1·5196		0·9417	0·4	192·8	167·5	0·5	14·5	10·5	17·9
11a	0·34	1·25	0·78	4·5		1·5178		0·9354		0·23		170·0			9·25	19·1
11b	0·34	1·15	0·76	3·55		1·5177		0·9346		0·25		169·0			9·25	19·2
12			0·2	2·7			1·5198		0·9410	0·7	193·5	167·0	0·5	15·0	9·5	18·1
13a	0·38	1·9	1·25	5·8		1·5180	1·5201	0·9372		0·55		160·7			8·75	21·2
13b	0·20	0·95	0·82	3·0		1·5186	1·5207	0·9355		0·33		163·8			8·75	19·3
13c	0·24	1·05	0·80	3·7		1·5181	1·5202	0·9353		0·40		163·8			9·0	19·5
13d	0·20	0·90	0·78	2·9		1·5192	1·5213	0·9360		0·41		165·2			8·5	19·6
14			0·2	1·7			1·5208		0·9417	0·4	193·2	169·0	0·5	15·0	9·5	17·2
15a	0·15	0·58	0·44	2·2		1·5179	1·5198	0·9345	0·9403	0·23		164·5			9·75	20·1
15b	0·18	0·62	0·66	2·7		1·5179	1·5198	0·9347	0·9405	0·22		164·0			10·0	18·8
16	0·18	0·76	0·50	2·0		1·5179	1·5198	0·9352		0·4		165·0			9·75	19·9
17	0·40	0·80	0·90	2·7	2·5	1·5172	1·5192	0·9351	0·9409	0·4		163·8			9·5	20·4

ALEURITES MONTANA

Southern India

No. 18.—A sample consisting of segments of fruits of rather small size, grown on an estate in Travancore, was forwarded to the Imperial Institute in November 1935.

The fruits contained a slightly higher percentage of oil than is usual for the fruits of this variety; the oil was of a good colour and exhibited the normal characters of montana oil.

Burma

No. 19.—A sample of nuts collected from trees growing wild on the China-Siam-Burma border of the Kengtung State, Burma, was received at the Imperial Institute in January 1934.

They contained a normal percentage of oil of satisfactory quality.

No. 20.—This consisted of nuts, received in January 1935, which had been collected from 3-year-old trees planted on a small experimental area in Tavoy, Lower Burma.

Their size, oil content, etc., were closely in accordance with the average values for the species, and on expression the kernels yielded a satisfactory oil.

Ceylon

No. 21.—A sample of fruits collected from estates in Ceylon was forwarded in December 1933.

They contained a satisfactory percentage of oil, which for a montana oil was of exceptionally good quality, being about equal to a rather low quality Fordii oil.

Hong Kong

No. 22.—This consisted of nuts grown on experimental plantations in Hong Kong and was received in March 1934.

The nuts were of an average size and contained a normal percentage of oil of satisfactory quality.

South Africa

No. 23.—A sample of nuts grown at Louis Trichardt, Transvaal, was forwarded in September 1936.

They were of normal size, with an oil content slightly above the average. The oil was of exceptionally good quality for montana oil.

Nos. 24 *and* 25.—A sample of nuts (No. 24), grown at Tzaneen, Transvaal, was forwarded in June 1935, and a further sample (No. 25) consisting of fruit was forwarded in June of the following year.

The first sample yielded a normal percentage of oil of average quality. In the case of the fruits received in 1936 the overall oil content was rather low. This may have been due to the fruits not being fully developed.

Kenya

No. 26.—A sample of fruits representing the first crop from trees grown at the Nairobi Arboretum was forwarded by the Conservator of Forests in July 1936.

They were rather small and not fully developed, and the amount of oil as expressed on the whole fruits was less than usual. The oil took longer to polymerise in the heat test than is usual with montana oil, and the percentage of unpolymerisable matter was higher. These differences may have been due to the immaturity of the fruit and/or to the fact that they were the first crop borne on the trees.

Nyasaland

Nos. *27a and 27b*.—Two samples of nuts, No. *27a*, from a specially high-yielding tree, " M13," and No. *27b*, described as " bulk seed," were forwarded by the Director of Agriculture, Nyasaland, in August 1934. The nuts from tree " M13 " contained a slightly higher percentage of kernel and the kernels were slightly richer in oil than the " bulk seed." The oil from " M13 " nuts gelled a little more quickly than that from the " bulk seed."

British Honduras

No. 28.—A sample of nuts, obtained from trees slightly over four years old, grown in British Honduras from seed imported in 1932 from Lancetilla, Republic of Honduras, was forwarded in January 1937. The nuts were somewhat larger than usual and contained a satisfactory percentage of oil.

The constants of the oil were within the range of figures obtained at the Imperial Institute for montana oils. The time taken in the heat test and the percentage of unpolymerisable matter were, however, unusually low, while the refractive index was above the normal, indicating that the oil was of very good quality.

TABLE III

ALEURITES MONTANA

Characters of Fruits, Nuts and Kernels

Sample No.	Whole Fruit.					Nut.				Kernel.			
	Average weight in grams.	Percentage Husk.	Percentage Nut.	Average No. of Nuts.	Oil in Whole Fruit as received.	Average weight in grams.	Percentage Shell.	Percentage Kernel.	Percentage of Oil in Nuts as received.	Average weight in grams.	Percentage Moisture.	Oil in Kernels as received, *per cent.*	Oil in moisture-free Kernels, *per cent.*
18		53·8	46·2			2·5	37·7	62·3	41·5	1·6	4·2	66·6	69·5
19						4·33	44·0	56·0	31·5		4·9	56·4	59·3
20						2·1	45·0	55·0	31·4		2·47	57·0	58·5
21	27·5	58·3	41·7	3·7	14·2	3·1	38·1	61·9			7·5	55·2	59·6
22						3·07	46·7	53·3	27·0		5·1	50·7	53·4
23						2·7	36·2	63·8	38·5	1·7	4·9	60·4	63·5
24						2·9	35·7	64·3	37·0		4·9	57·5	60·5
25	19·2	60·8	39·2	3·0	13·4	2·5	41·6	58·4	34·1	1·7	5·5	58·4	61·8
26	11·1	65·0	35·0	1·7	12·0	2·3	41·2	58·8	34·3	1·4	5·7	58·3	61·8
27a						2·68	36·9	63·1	38·6		5·8	61·2	65·0
27b						2·59	38·1	61·9	37·6		5·1	60·7	63·9
28						3·5	43·8	56·2	34·9	2·0	4·9	62·1	65·3

TABLE IV

ALEURITES MONTANA

Characters of the Oil

Sample Number.	Colour. Lovibond cell. 10 mm. Red.	Colour. Lovibond cell. 10 mm. Yellow.	Colour. Lovibond cell. 1 in. Red.	Colour. Lovibond cell. 1 in. Yellow.	Colour. Paint Res. Sta. Scale.	Refractive Index. $n_D 25°C.$	Refractive Index. $n_D 20°C.$	Specific Gravity. at 25°C.	Specific Gravity. at 15.5°C.	Acid Value.	Saponification Value.	Iodine Value, Wijs, *per cent.*	Unsaponifiable Matter, *per cent.*	Heat Test. Brit. Stand. Spec. Method, mins.	Heat Test. Paint Res. Sta. Method, mins.	Heat Test. Extractive matter (unpolymerisable), *per cent.*
18			0·6	7·0			1·5166		0·9395	0·5	193·7	164·8	0·5	21·5	12·25	24·5
19	0·90	9·8	1·85	27·0	5A	1·5139	1·5159	0·9340	0·9393	1·54		162·6			12·5	30·3
20	0·60	3·5	0·50	20·0	4	1·5130		0·9321		0·3		163·8			14·75	31·9
21	0·72	3·2	1·5	15·0	4A-5	1·5170	1·5190	0·9355		0·78		164·6			9·5	22·7
22			1·15	18·0	4A-5	1·5148	1·5168	0·9345	0·9398	0·41		166·0			11·75	25·7
23			0·6	5·0			1·5185		0·9404	0·6	192·3	167·4	0·5	17·0	10·25	23·3
24			1·75	3·0	5	1·5138		0·9357		0·29		164·8			10·5	27·8
25			2·0	20·0			1·5142		0·9384	0·4	194·5	158·2	0·4	23·5	15·0	34·7
26			1·5	19·0			1·5132		0·9389	0·9	192·2	160·3	0·4	26·5	17·0	39·2
27a	0·60	2·9	1·0	13·5	4	1·5131	1·5152	0·9339		0·67		155·6			12·75	29·4
27b	0·58	3·1	0·95	14·0	4	1·5129	1·5150	0·9336		0·65		157·6			13·0	
28			1·0	17·5			1·5182		0·9404	1·0	191·7	164·5	0·5	17·25	11·25	23·0

CAMEL HIDES FROM BRITISH SOMALILAND

ALTHOUGH camel hides are used for the production of crude native leather in Africa and Eastern countries, they do not appear ever to have been used to any extent by the leather industry in Western countries. When, therefore, in 1933, a sample of camel hide leather tanned in this country by the chrome process was sent to the Advisory Committee on Hides and Skins of the Imperial Institute by the Chief Veterinary Officer in British Somaliland, the opportunity was taken of obtaining the views of the trade as to the likelihood of such material finding a market here. Subsequently several small consignments of camel hides were furnished for tanning trials and some interesting results were obtained. It was eventually found that, owing to the position of the camel in the economy of the native, there was no possibility of obtaining hides of sufficiently good quality in commercial quantity. Nevertheless, in view of the paucity of information as to camel leather, it is considered desirable to place the results of the investigation on record, and a summary of the reports sent to the British Somaliland Government is given in the following pages.

The sample received early in 1933 consisted of three pieces of chrome-tanned leather, finished black with an embossed grain, known to the trade of this country as "pebble grain." Enquiries showed that the trade would be quite willing to take an interest in the product provided that the price at which it can be offered was satisfactory. It was considered that pebble-grain finished leather, as represented by the sample, might at the best be used for sports shoes (uppers). If it did not succeed for this purpose it could be employed for a cheap line of boots such as miners' and agricultural workers' boots.

A representative of a firm of hide and skin brokers, who is a member of the Committee, was of the opinion that leather equal in quality to the best portions of the sample, but finished in natural grain, would find a market as a good class or speciality side leather for the best class hard-wearing or sports shoes. His view is supported by the following report from a firm of leather merchants in Northampton, to whom the sample was submitted:

"I have now examined the sample black chrome tanned camel hide which you sent me, and after consulting one of

the leading shoe manufacturers I beg to give you the following report:

" *Tannage.*—I have not actually made a test, but the sample appears to be fully chromed, containing quite $3\frac{3}{4}$ per cent. of chrome or more.

" This tends to make it firm, but it is not a fault as the leather is very tough and should be thoroughly waterproof.

" *Flesh.*—There is too much loose flesh on the leather. The skins should be carefully clean fleshed but not split, as this would take away much of the waterproof qualities.

" *Grain.*—The printed grain on the sample is inclined to give the impression that the leather is similar to cheap printed side leathers, which are on the market at prices from $8\frac{3}{4}d.$ to $10\frac{1}{2}d.$ per sq. ft. To establish this camel leather as a speciality, I think it would be better to leave the natural grain as shown on the fold at the edge of the sample. To get a grain similar to the Scotch Zug leather used in best grade shoes the finish should be dull, and to get a grain like Willow Calf it should be bright. Printing on the grain like the sample would, of course, help to hide any defects on the grain of the leather.

" If, however, the grain of this leather were left plain and the skins were of good cutting value, without brands or scars and thoroughly waterproof, it could be used as a speciality for shoes requiring hard-wearing leather.

" *Colour.*—Black might sell, but I think that a good medium dark brown would prove more attractive.

" *Rounding.*—The sample seems fairly well rounded, but, of course, the closer the skin could be rounded, to avoid waste in cutting for uppers, the better price could be obtained for the leather.

" I presume that supplies of this camel leather would be rather limited, and, if so, I suggest that if it could be suitably finished it would be better to put it on the market at a price which would be above the side leathers at present being sold."

The results of these preliminary enquiries were duly furnished to the authorities in British Somaliland and suggestions were made as to further action which seemed desirable in order to ascertain more definitely the prospects of using camel leather in this country. Later in 1933 the Chief

Veterinary Officer sent over a consignment of 34 sides of camel hides. These were forwarded to a firm of tanners in Leeds, and, in accordance with suggestions which had been made by members of the Committee, were given a vegetable tannage as far as the crust stage (i.e., rough tanned, unfinished). The firm reported that of the 34 sides, 6 were only fit for glue, and the remaining 28 were sorted roughly into 5 firsts, 11 seconds, and 12 thirds.

The tanned sides were submitted for inspection by the Committee. In the crust state it was seen that the grain on the 12 sides graded as thirds was in very bad condition owing to decomposition which had apparently occurred before drying. In no case was the grain sufficiently good for a finish as natural grain.

It was decided to finish the first and seconds as upper leather and the thirds as a commoner class of sole leather. This was accordingly carried out. The 16 pieces comprising the firsts and seconds were split, stuffed, dyed black, and embossed with an artificial grain. The 12 pieces (thirds) were left in the natural brown colour of the tannage and finished as " Rolled Camel Hide."

Sample pieces of the finished leather were later submitted to the Committee, and it was decided that the firm who had tanned and finished the leather should be asked to dispose of it to the best advantage in order to test the market.

Considerable difficulty was experienced in finding a customer, however, and on account of the leather being unknown in this country and the small size of the parcel, it was only possible to dispose of it as a job lot at a low price.

The Committee considered the results of the sale in conjunction with the opinions they formed from an inspection of the crust and finished leather and submitted the following observations to the British Somaliland Government.

"The best hides of the consignment were made into upper leather with a view to testing its suitability for the uppers of shoes and boots of a fairly heavy type. It proved, however, to be much softer than the leather ordinarily used for this purpose, but on account of the faults in the hides the leather could not be considered for higher class work.

"The remainder of the hides, those showing the most damage on the grain side, were made into sole leather, which

was only suitable for the purpose of insoleing in the cheaper class of boots.

"The prices realised for the leather were low, and, in the opinion of the Committee, the prices which would probably be realised for larger consignments of camel hides of the present quality as regular commercial lines are too low for the export to prove remunerative.

"The consignment was of poor quality and suitable only for cheap trade purposes, firstly on account of putrefaction which had taken place, seriously damaging the grain side in many cases, and in six sides rendering them fit only for glue making. This fault had been caused either by delay before drying or by imperfect drying. The second factor contributing to the poor quality of the present hides was the fact that many were apparently from animals that had seen long service and were consequently of rough grain and mechanically damaged.

"The Committee was of the opinion that better prices would be secured for leather made from well-dried hides, reasonably free from damage, such as those obtained from younger camels. If it were practicable to export such hides, which could be classed as prime hides, in commercial quantities, a remunerative market might be established for them, but consignments of the quality of the lot which had been investigated would not be worth shipping."

Apart from the main investigation of the possibilities of using camel hides for the manufacture of leather, to which the above report refers, a member of the Committee undertook to arrange working trials to ascertain if the camel hides would be suitable for more specialised purposes in the leather industry. At the request of the Committee 12 hides were sent over for this purpose in January 1935, but these were found to be badly cut and scored on the flesh side. A few of the best sides, however, gave promising results, and the firm concerned expressed their desire to carry out further tests, and 12 more sides were supplied in May 1935.

The reports which were received regarding the working trial with this second set of 12 sides also proved disappointing as they showed that the hides had suffered in preparation, with the results that much of the grain had been damaged.

The 12 sides were divided between two firms of tanners, who reported on their working trials as follows :

(*a*) "The sample camel hides you sent us some time ago have now come out of the pits and we have examined them in the rough tanned state. We find that the greater part of the grain is defective, the grain having become decayed in the early processes. Owing to the very defective state of the grain on the camel hide leather, we do not know what we can do with it except to roll it off for insole or other common purpose."

(*b*) "The six camel hides which you sent to us were split into sides and put through the usual chrome tanning processes; there are only four sides, which are equivalent to two hides, which have come out worth any value. The others are in such bad condition that they have turned out useless. We are quite convinced that the preparing of the raw material is the cause of the very bad outturn in the tannage. We will return to you what there is left of the poor sides as we think it would be best for you to see for yourselves how bad they really are. The other four, which are reasonably good, we suggest finishing in a brown colour suitable for shoe leather. We tried one with the idea of making it into gloving leather but it was unsatisfactory.

"Our considered opinion on these camel hides, after having seen the two lots which we did for you, is that they would not be a practicable proposition to bring into this country unless you get at least 80-90 per cent. good leather."

The above results were discussed by the Committee, who made the following observations:

"The present consignment of hides shows damage to the grain in similar manner to the previous consignments. This damage is due to putrefaction, caused either by delay in commencing the drying or by imperfect drying. A few of the sides were reasonably free from damage and yielded satisfactory leather. The leather from the best sides would be worth 7*d*. to 8*d*. per sq. ft., which would make the value of the dry hides about 5*d*. to 6*d*. per lb. It is estimated that a price of this order should prove remunerative to exporters in British Somaliland.

"It must be realised that such a price could only be paid for consignments of sound hides which yielded 80-90 per cent. of leather free from defects.

"These trials clearly show that camel hide would be suitable for manufacturing purposes in the United Kingdom and

would be readily saleable if the hides were free from damage and well prepared, but hides in the condition of the present and previous consignments would not be worth shipment."

In submitting these observations the Committee made the following recommendations for preparing camel hides for export.

In the first place only hides which are reasonably free from wounds and other damage should be selected. These should be stretched out and hung up for drying immediately after flaying. The hides should be suspended in order that air may circulate freely on both sides of the hide. In this manner thorough drying is effected which reduces the risk of putrefaction.

The British Somaliland Government were asked for their observations as to whether the export of well-prepared sound hides as detailed above in commercial quantities is likely to be a feasible undertaking in Somaliland. The Imperial Institute has been informed that after careful consideration the conclusion has been reached that hides of the requisite quality are not obtainable in commercial amounts. While the camel population of Somaliland is considerable, the animal is a unit of capital value with the native owners, and it is seldom that an animal is killed unless for meat on a special occasion. In these circumstances no export trade is to be expected, nor is it thought to be feasible to endeavour to build up a trade.

ARTICLES

THE IMPERIAL INSTITUTE'S SERVICES TO SOUTH AFRICA[1]

By SIR HARRY A. F. LINDSAY, K.C.I.E., C.B.E.

Director of the Institute

ON a summer's day in 1887 Queen Victoria laid the foundation-stone of the building which was to be known as the Imperial Institute. By coincidence, that foundation-stone was of Cape Colony granite, so that the connexion between South Africa

[1] A paper read at a joint meeting of the Dominions and Colonies Section of the Royal Society of Arts and the Royal African Society held on April 6, 1937, and reprinted by kind permission from the *Journal of the Royal Society of Arts*.

and the Institute began at a very early stage in its history. It was rather an occasion. The Colonial Governments, the Indian Princes, the merchant adventurers of the City of London, had all subscribed to a building which was to commemorate the great Queen's Golden Jubilee. The Prince of Wales, later King Edward VII, was Patron of the fund and first President of the Governing Body. All the world and his wife were there, dressed in their best. The Institute was destined to be—and still is—a central clearing-house of information about the economic resources of the Empire.

Now I do not propose even to try to give you an account of the successive stages through which the Institute has evolved. That might be interesting, but it would not be relevant to our present enquiry, which relates to the services now rendered by the Institute to the Union of South Africa. So I propose, with your permission, to skip the half-century between 1887 and 1937 and to pass at once to present-day events—with this one rider, that, in singling out South Africa for this talk, I am merely trying to illustrate, by examples drawn from our relations with the Union, the sort of work which we do, or can do, for other parts of the Empire as well.

Last year the Board of Governors—who in conjunction with the Department of Overseas Trade are responsible for the affairs of the Institute—decided that I should visit the Union with three main objects in view: firstly, to make sure that people in South Africa, whether officials or non-officials, should realise clearly the facilities offered by the Institute in the service of all countries of the Empire; secondly, to try and improve on our existing collections of exhibits for the South African Court in our Exhibition Galleries and of South African films for our Empire Film Library; and, thirdly, to visit the Empire Exhibition at Johannesburg and to study there the latest developments in exhibition technique.

Here let me digress for a few minutes to explain that our work at the Imperial Institute is two-fold. In our laboratories and intelligence offices we investigate and report on economic products sent to us from all parts of the Empire, and we answer enquiries about such products. Secondly, we show, choosing the most popular methods available, just what the Overseas Empire stands for, country by country, its life, scenery, industries, etc. This we do partly by means of

exhibits in our Exhibition Galleries and partly by means of films in our Cinema. And inasmuch as only the public in London, or visiting London, can come to our Cinema, we also maintain a library of Empire films, known as the Empire Film Library ; these Empire films we circulate on loan to schools and social and educational societies all over the United Kingdom.

To deal with our technical work we maintain a staff of about forty scientists, who in their turn are most ably backed by the experience and expert knowledge of the members of our Advisory Councils and Committees. Each Committee deals with a special branch of economic production—Vegetable Fibres, Timbers, Oilseeds, Precious Metals, Base Metals, and so on—fifteen Committees in all, of which eight serve on the Plant and Animal Products side of our work and seven on the Mineral Resources side. Our two Advisory Councils control the work of these Committees, one Council for Mineral Resources under the chairmanship of Sir William Larke and the other for Plant and Animal Products under the chairmanship of Sir Frank Stockdale. These Councils and Committees, by their constitution and personnel, bring to bear on the technical problems which face us in the course of our everyday work at the Institute the knowledge and experience of scientific experts, business experts and administrative experts. It does not mean that because all of them are experts they are necessarily going to agree. Not at all. They bring their different and varied experience to bear on a particular problem before them, and when we get light thrown on it from all these different and varied agencies, we get something that is very valuable to us indeed, and I take this opportunity of giving full credit to those business men, scientists and administrators who find the time to come to us at the Imperial Institute and give us their very valuable opinions. Indeed, I do not know how we should get on without them.

An important point is that we exist solely for the service of the Empire Governments. They are our clients, and it is they who decide what sort of work we are to do. It is they who send us their economic products for investigation in our laboratories and who call on us for market reports ; we exist solely in order to meet their demands on our time and services.

The other side of our work is what might be called the Empire Publicity, or propaganda side. You may remember

that in the old days of the Empire Marketing Board the Board was divided into two halves, the technical side and the publicity side. I have described very briefly the technical side of our work, and now I should like to say a few words in regard to the publicity side. The Empire Marketing Board made a great feature of " background " Empire publicity, which must be distinguished from " foreground " publicity. Foreground publicity is that given by the man who, in order to try and sell his goods to the best advantage, simply puts the word " Empire " on them and hopes for the best. There is no objection to that, and he is quite entitled to do it. It is all necessary and part of the game, but there must be somebody doing the background publicity as well—that is to say, publicity which inspires a general goodwill for the producers of the Empire in this country—and that is the work which we are doing in our Exhibition Galleries and in our Cinema.

I like to think of this part of the work of the Imperial Institute as a sort of combination of a picture gallery and a storyland of the Empire. The picture gallery is provided by our Cinema and our Empire Film Library, and the storyland is provided by our Exhibition Galleries. These Galleries are divided up into Empire Courts. Each part of the Empire has its own Court, where we try to tell the story of the Empire country concerned. Imagine to yourselves four great Galleries running east, west, south, and north. Start at the East Entrance with India, Burma, and Ceylon ; then follow the course round through the North Gallery, by way of Aden, Sudan, Somaliland to East Africa ; South Africa occupies the centre of the North Gallery ; thence through West Africa, Palestine and the Mediterranean Colonies to Canada, which appropriately occupies the whole of the West Gallery ; through the South Gallery are Newfoundland, the West Indies, New Zealand, Fiji, Australia, Borneo, Hongkong and Malaya ; and so back to the East Gallery. It is a sort of grand tour of the Empire, and follows the correct geographical sequence. There is something in that because it means that the school parties which come to see the Exhibition Galleries learn instinctively where to place each country, and also learn what that country stands for and what it produces in the Empire. Some people like to call that visual instruction, and I think it is a good term for it. When we were young we found it difficult to absorb the

lessons of the ordinary school geographical text-book. Why? Because all successful education depends on some emotional impulse which is necessary to hold your interest throughout the whole of the story. You cannot always rely on a book for the inspiration required. You must be able to picture to yourself the country which you are studying, and that is exactly our objective at the Imperial Institute. We provide a picture of each country of the Empire by means of models, photographs, dioramas, etc., so that the illusion may be as complete as possible.

Then, with regard to the economic products of the Empire, we are gradually moving away from the old theory that exhibits should be merely a dull collection of objects, towards the new class of exhibit, which tells the complete story of some natural product, from the point where it is harvested or mined or felled in the overseas Empire through the various intermediate processes to the final stages of manufacture.

I will not stop to describe the Cinema and Film Library save to say that the Cinema shows Empire films in four daily sessions, and the Empire Film Library circulates Empire films throughout the United Kingdom. We have over 2,500 schools on our registers, and those films are circulated without any charge, save for postage and return. Nearly five million people, mostly children, saw those films last year. And thus, with its Exhibition Galleries, its Cinema, its Empire Film Library and its popular Empire lectures, the Imperial Institute claims to be at the same time the storyland and the picture-gallery of the Empire.

Now I must revert to my tour to and through the Union of South Africa; I will be very brief, just picking out a few points which will lead up to the final conclusions of this talk. I landed at Cape Town towards the middle of December with several letters of introduction to present and only three days in which to present them. However, I managed to pack a good deal into those three days. My first host was Sir Carruthers Beattie, Vice-Chancellor of the University, who was kindness itself. He and his friends entertained me to lunch and gave me an opportunity of explaining the work we do at the Institute and the services we render to South Africa. I described the South African Court in our Galleries, and the exhibits there, the South African films in our Film

Library, and the technical work we do on the economic products of South Africa, animal, vegetable and mineral. Later, I was taken for a most delightful drive through the Drakenstein and Paarl fruit-farms, where I concerted with the Deciduous and Citrus Fruit Exchanges and with the Winegrowers' Association new and improved methods of showing fruit and wine exhibits in our South African Court at the Institute. At Cape Town I met the Hon. A. P. J. Fourie, Minister for Commerce and Industry, and the Hon. Patrick Duncan (now Sir Patrick Duncan, Governor-General). At Pretoria I found that General Hertzog was at his farm, but I met other members of the Cabinet, General Smuts, Colonel Denys Reitz, Mr. Hofmeyr and Mr. F. C. Sturrock; also the permanent Secretaries to Government in charge of Commerce, Agriculture, Mines, and Education.

At Durban and Pietermaritzburg I met representatives of the chief sugar and wattle interests, and of the Chamber of Mines at Johannesburg, where I spent a very happy and profitable three weeks, visiting the Empire Exhibition almost daily. I felt that at the Exhibition I should be able to catch exactly the atmosphere which must be reproduced in the South African Court at the Imperial Institute, and I was not disappointed. The Pavilions of the Durban and other Municipalities were beautifully equipped and arranged. The Western Province Pavilion, in particular, represented an old Dutch house exactly as built and furnished in the eighteenth century. At this Pavilion also I was shown a number of singularly beautiful colour-films of Cape Town and Cape Province; and many of these films will, I hope, be sent to the Empire Film Library for circulation to schools throughout the United Kingdom. I visited the premier Veterinary Institute of the Empire at Ondersterpoort, and at Potchefstroom a well-known Experimental Farm of the Union Government.

Let me stop here to say that the natural colour effects of a South African landscape simply beggar description. I was unlucky enough to be too late for the full bloom of the Jacoranda tree at Pretoria and too early for the Flamboyant at Durban; nor did I get a chance of seeing the Karroo in flower. Nevertheless, the picture which I have carried away with me of South Africa is one of colour everywhere—distant plains and horizons of blue and opal and amethyst, flowers in

every garden and flowering trees and shrubs in many streets, and every sunset, almost, a flame of fire. The dominant note was colour—I have never seen anything like it—even the weary miles of scrubland or rock and sand contributed their own particular shades and hues to a perfect whole.

At the Empire Exhibition I was naturally much attracted by the Union Government Pavilions describing progress in the mining, agricultural, and pastoral industries; by the Iscor Pavilion showing what South Africa can produce in iron and steel; by the Gold and Diamonds Pavilion, with exhibits so valuable and so beautifully displayed that the queues waiting to enter it measured many yards in length. Besides the United Kingdom, Canada, Australia, New Zealand, Ceylon, the East African Colonies, the Rhodesias and Nyasaland were represented; also the Port of London Authority. The United Kingdom Pavilion was popular, with its model exhibits of transport by air, water, road, and rail; and it was architecturally intriguing, for one entered from the dazzling sunshine outside into a Pavilion of comparative darkness whose perfect balance and symmetry of form revealed themselves gradually as one's eyes grew accustomed to the half-lights and shadows.

Through the courtesy of Mr. Brigden, H.M. Trade Commissioner at Johannesburg, and Captain Baynes, of the United Kingdom Pavilion at the Exhibition, I made many useful contacts, and was fortunate enough to have opportunities of addressing local clubs and associations and of interesting them in the work of the Imperial Institute. Twelve talks in three weeks is not a bad effort—nine at Johannesburg, one at Pretoria, and two at Durban.

I returned home by air from Johannesburg in January, spending three weeks in Kenya Colony on the way.

In summarising the results of my visit to South Africa, let me explain at once that I started with one big advantage—I was not appealing for funds! The Union Government revived their annual contribution to the finances of the Institute in 1935, and I was therefore in the happy position of having to explain the facilities which we make available to contributing Governments and of making certain that these facilities were widely and clearly understood throughout the Union, not merely by technical Departments of the Government, but

also by agricultural, commercial and industrial organisations and by their members. I think I was able to get my story across. I have brought back with me many promises of co-operation —and not promises merely, as the exhibits for the South African Court in our Exhibition Galleries and the South African films for our Empire Film Library prove—co-operation with the technical officers of the Union Government in scientific matters, agricultural, veterinary, forestry, mining, and so on.

The reorganisation of the South African Court in our Exhibition Galleries is likely to attract considerable attention, since it will be the first Court in which, in conjunction with the High Commissioner and the Union Government, we shall be able to work out a new technique. The Publicity and Travel Bureau of the South African Railways have prepared for us a magnificent set of coloured photographic transparencies, illustrating the finest views of natural scenery in South Africa together with scenes of historic or architectural interest. These have just arrived in London and are being arranged in the South African Court in the form of a travelogue. Each transparency has been painted by hand by a skilled artist, and the whole will be lit up in an attractive manner, with maps showing what point is reached by the visitor in his imaginary tour round the Union.

Then, again, the exhibits of the premier industries of South Africa will be arranged in such a way that each will tell its own appropriate story. We have already prepared show-cases to illustrate the wattle industry from the plantation and the bark to the finished leather, the maize industry from the field of maize and the cob to the resulting cornflour, starch, etc., the ostrich feather industry, mohair, asbestos and other minerals. Indeed, the minerals displayed in the South African Court, when it is finally complete, will be a special feature of the Court, thanks to the co-operation of the Government Mining Engineer (Dr. Hans Pirow) and the Director of the Geological Survey (Dr. Haughton), as well as the industrial companies and associations concerned. There will be nine show-cases, each given up to a mineral or group of minerals—gold, diamonds, the base metals, abrasives, and so on. Photographs and specimens will show the mining operations in South Africa, together with all stages of processing up to the finished articles.

I was also fortunate enough to secure the co-operation of an artist modeller employed by the Department of Agriculture at Pretoria. This lady will prepare exact models of the principal fruit crops of the Union—branches of peaches, nectarines, paw-paw, avocado pear, granadilla, oranges, lemons and other citrus fruit, grapes, and so on. This will be the first time that we have been able to show exact representations of living plants and fruits, many of which cannot be seen in this country. All these show-cases will be arranged in co-operation with the High Commissioner's staff; we also show in this Court dioramas of South Africa which are periodically interchanged with the dioramas on view in South Africa House.

Only a week ago a consignment of fifty reels arrived for us at South Africa House, and this was merely a beginning, for we are expecting many more films of South Africa, both sound and silent, for our Cinema and Empire Film Library. May I take this opportunity of expressing my great obligation to Mr. Te Water and his staff for their kindness in making things easy for me during my tour? Their introductions were invaluable and worked wonders for me in all my new contacts. We at the Institute work in the closest possible contact with South Africa House so as to avoid all possible risk of overlap. All films and all exhibition material destined for the Institute become the property of the High Commissioner and are passed on to us on semi-permanent loan, so that they first receive the official hallmark of his approval. All trade enquiries from or relating to South Africa are considered at the Institute only in collaboration with South Africa House, and special attention is paid to mineral enquiries, to which the Union Government and the High Commissioner naturally attach considerable importance.

A feature of institutions such as ours is that specialist bodies arise which naturally take over functions which we used to perform. That is a perfectly normal development and a healthy one. We are not a research body, and new organisations such as I have described are usually research bodies. We maintain close touch with them and we help them so far as we can be relieving them of investigational work which they are not so well fitted as the Institute to carry out. It is the same thing in our relations with the High Commissioners. At one time it seemed as if the High

Commissioners and Trade Commissioners for the Dominions would render our work unnecessary. But this is by no means the case. Their knowledge and their experience in relation to economic products are limited to the products of their own countries. Our experience is based on nearly fifty years' handling of the economic products of the whole Empire. Similarly, our propaganda services, in our Exhibition Galleries, our Cinema, Empire Film Library and lectures, are rendered to the Empire as a whole. The one big asset which we have to offer in all our Empire propaganda work at the Institute is an asset which no Government of the Empire can afford to do without and that is goodwill. For goodwill helps to sell goods in the best markets. It helps with travel facilities. It helps to oil the wheels of all the complicated machinery which nowadays goes to the make-up of a national Government. We are working not in our own interests but in those of the Empire Governments which we serve.

One more point. I returned home with quite a new impression of the Empire, and of the relative values of its centre and its circumference. I used to think rather complacently of London as the hub of the Empire, of which the various Dominions, with India and the Colonies, represented the rim. Well, if that is a mathematical picture, I now wish to revise my mathematics. The traffic of new ideas, new methods, new ideals, is by no means a one-way traffic from the centre outwards. London receives, I am quite sure, as good as she gives in exchange in the intellectual and creative spheres. Let me give one or two concrete examples. Canada was certainly first in the field with preferential Empire tariffs and it took this country a long time to follow suit. Australia made some mistakes, perhaps, with her labour and wages legislation during the early part of this century, but they were mistakes from which the rest of the Empire profited, and the United Kingdom not least. India, with her "discriminating protection," gave, I am sure, a sound lead to the protective policy which this country adopted in 1931.

During my tour of South Africa I noticed several directions in which the Union Government is "giving a lead"—its taxation, aimed at conserving its gold resources, is one example. Then, again, the Special Service Battalion of the Union Government is a new idea which has admirable and practical

results. The unemployed youth there are invited to recruit in this battalion, where, on the basis of a shilling a day pocket-money, clothes, board and lodging all found, the recruits live a disciplined life, including a certain amount of drill, but not too much, and receive also a training in some industry or service in which they are, if possible, found employment. It sounds an excellent system, and may perhaps be worth considering in this country.

Last, but not least, I found in South Africa a new orientation in regard to the Empire itself. Put philosophically, the problem is just this: every organism, great or small, must either increase or decline; it must either go on or go under. That is true not only of living organisms but of national organisations as well. It is true of commercial and industrial firms. It is true of Empires. Now my point with regard to the British Empire is just this. Whatever happens, it cannot possibly go on expanding quantitatively. There is simply no room in the world for any further expansion—nor would we contemplate it if it were possible. We have to look at the Empire more and more in the future not as a quantitative but as a qualitative thing. It is in regard to its quality that it can and should grow, not in regard to its quantity.

The fact is, that we have come to speak of the Empire so much and so often in terms of square miles of territory or heads of population, or millions sterling of finance or trade, that we often forget to overlook this cardinal factor of our Empire, namely, that it is based not on a unity of race or language or religion, but rather on a community of ideas, or, if you prefer it, of ideals. We are all, more or less, after the same objectives—a raising, if possible, of standards of living at present low amongst our members, certain standards of common honesty which all accept, a certain tempering of justice with mercy, a certain tempering of idealism with common-sense, a certain balancing of individualism against the common weal, so that the best type is the individual who has his neighbour's interests closest at heart.

In other words, our Empire is an inheritance, and the one thing which saves an inheritance from dissolution or decay is just the tradition—the spirit, if you will—which infused it and built it up. This tradition we must not let down; if we can, we must pass it on to our descendants enriched and ennobled.

That is one lesson which I brought back with me from South Africa. A second lesson is not far removed from the same thought. It is, that unity in the Empire comes not from any sense of uniformity. Our unity springs rather from diversity. Why? Because if there is to be hope for the future progress of our Empire, it can only come through the throwing out of new forms, new ideas, new opinions; and these new forms and opinions can only come through the liberty of the individual. Unity which is merely the product of the drillmaster can never be truly progressive; unity with progress can only come through liberty and through the power of the individual to choose and develop his own life. I think it has been expressed very well in the three lines:

"In essential things, unity;
In doubtful things, liberty;
and in all things charity."

RECENT IMPROVEMENT OF AFRICAN OIL PALMS AND PALM OIL PRODUCTION IN THE BELGIAN CONGO

By Professor Edm. Le Plae,
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The trade in palm kernels and palm oil in the Belgian Congo had never been extended farther inland than 40 or 50 miles, nor had the thousands of palmeries of Central Africa ever been exploited, when, in 1912, the late Lord Leverhulme (then Sir William Hesketh Lever), head of Lever Bros., Ltd., obtained from the Belgian Government a large concession of palm-bearing lands, in the Central Congo, at an average of 650 miles from the coast and the harbour of Matadi.

The palmlands conceded are grouped in five Circles, each of a radius of 36 miles, and located in the best palm countries of the Congo, on the Congo River or a river navigable for steamers. The total extent of these concessions approximates to 1,800,000 acres.

In accordance with the terms of the grant, a new company was formed to work these concession, under the name of *Les Huileries du Congo Belge*, and pledged to build five oil

mills, each having a minimum annual capacity of 6,000 tons of fruit, and also to provide in each Circle, for the benefit of the natives, medical help, hospitals and schools. The capacity of the mills was to be raised to 15,000 tons of fruit at the end of the first ten years.

The new concern started work in 1912, built the mills rapidly, with the necessary motor roads and narrow gauge railways, and launched on the river a fleet of steamers and barges. In 1936 the Company owned 20 steam oil mills, having an effective capacity of 129,000 tons yearly. It also had a fleet of 35 steamers with stern-wheel, screw or vane-wheel propulsion, and a large number of 20 to 30-ton barges, the aggregate tonnage being 7,200 tons. The palm oil is carried in bulk on tank-cars and tank-barges, stored in huge tanks near Leopoldville and Matadi, and shipped to Europe on tank-motor vessels.

The lead given by this Company was followed by several Belgian firms, and the output of oil and kernels of the Congo rose steadily after the War. Starting from a small annual export of 2,000 tons of oil and 6,000 tons of kernels, the Congo is now the second largest exporting country in Africa as regards palm oil and kernels, and occupies first place in respect of steam oil mills. At the end of 1936 the number of such mills working in the Congo was 73, with individual capacities ranging from 1½ to 25 tons of fruit per day of ten hours. Hand presses and boilers are at work in the smaller concessions; they are of Belgian or Dutch make, and number 140 sets.

The rapid increase of the palm industry in the Congo is shown by the following figures, relating to the three principal exporting countries of the West Coast:

	1920.			1935.		
	Kernels.	Oil.	Total.	Kernels.	Oil.	Total.
	Tons	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*
Nigeria . .	210,322	89,763	300,085	317,741	144,811	462,552
Belgian Congo .	39,435	7,624	47,079	64,996	59,221	124,157
Dahomey . .	29,340	11,411	40,751	61,123	23,906	85,029

The total increase of the tonnage exported from 1920 to 1936 is 54 per cent. for Nigeria, 164 per cent. for the Belgian Congo, and 108 per cent. for Dahomey.

The Central Congo has a yearly rainfall of 60 to 80 inches,

and consequently is covered by forest growth, with thousands of palmeries of all sizes; some are a few acres, and some hundreds or even thousands of acres. These palmeries originated partly through the dissemination of palm fruits by birds, monkeys, rats and forest pigs, but mostly through the action of the natives, who use the palm oil in the preparation of their daily food and formerly threw the nuts in the bush, so that each village became surrounded by a belt of young palms. As these natives practice shifting cultivation and move their villages frequently, they start palmeries in many places, some of these amalgamating in medium-sized and some in large palm forests. The natives never destroy oil palms, excepting a very small number tapped for palm wine.

The densities of these natural palmeries range from 10-19 palms per acre to 50, 100 and even 300 per acre. Where the oil palms are overcrowded by reason of their own number or by the presence of other trees, they grow up to reach the light and become very tall, but many bear little or no fruit. When, however, these palmeries are thinned by the up-rooting of the superabundant palms, the young and the adult trees soon begin to bear fruit, and the palmeries give an annual harvest of about one to one and a half tons of fruit per acre. On account of the frequent rains two weedings a year are necessary to keep the land clean. This is expensive, and experience has shown that the cost of the clearing and weeding is not repaid by a corresponding crop increase. Accordingly, most of the palm working concerns now limit their expenses to spacing the trees and cutting narrow paths through the undergrowths for the transport of the fruit. These paths connect the palms with the narrow gauge railways and motor roads. A few plantations use trained African elephants for transporting the fruit.

Systematic improvement of the palm varieties began after the war, when the palm industry became of great importance in West Africa and the Congo. The Agricultural Department, realising that some varieties of palm were very rich in oil, ordered that seeds of these should be gathered in the several districts of the Congo and planted in a 500 acre field at Bolombo near the Botanical Gardens at Eala. A comprehensive survey of the varieties of oil palms was made by one of the Government chemists, and the percentage of pericarp oil and kernels in the different varieties was shown to be as follows:—

Variety.	Oil.	Kernel.	Variety.	Oil.	Kernel.
Eologo (Equator) .	37·70	8·10	Bobei (Barumbu) .	48·12	5·95
Esombe ,, .	42·14	6·04	Futshi (Saukuru) .	40·94	10·36
Djongo ,, .	50·17	5·34	Tshombo (Kasai) .	41·69	8·40
Mohei ,, .	34·60	13·97	Mfomfo (Kwango) .	49·30	9·26
Mohei ,, .	40·06	6·31			

Regular work on the improvement of varieties was started in 1922 on the Government Experimental Plantation of Yangambi, near Stanleyville, by Ringoet, Manager, on his return from the Netherlands Indies and Malaya, where he was sent to study the selection of rubber trees and the new palm plantations. His first work was to plant a very large number of the best variety of oil palms, from which, by selection, thousands of valuable trees would become available. The five following plantations were established.

I. *The Riverbank Palmery.*—This is the oldest palmery planted with the *Mohei* variety. It covers 10 acres, in a perfectly isolated plot, on the bank of the Congo River. It was planted in 1922 with seeds of *Mohei* palms sent from Eala and the Bambale palmeries. *Mohei* is the local name given to the *Tenera* type of palm, called *Esombe* or *Lisombe* in other parts of West Africa. The 1,880 palms were planted thickly at a spacing of 2 × 10 metres, in order to allow of severe thinning, and they were subsequently carefully surveyed, and all those that did not belong with certainty to the *Mohei* variety were uprooted. This drastic elimination brought the number down in 1931 to 563 palms. During the period 1931 to 1933 a further thinning took place, and all the trees that did not reach the required standard in respect of the amount and composition of fruit and bunches were discarded. Only 170 oil palms are now left on these 10 acres, but this palmery is believed to be pure *Mohei* variety, and constitutes a most valuable asset for the improvement of oil palms. The following characters were noted for each tree during five years (1929-1934) :—

Annual number of bunches.
Weight of these bunches.
,, of stalk.
,, and number of aborted fruit.
,, and number of external and internal fruit.
,, of pulp on weight of fruit.
,, percentage of shell on weight of fruit.
,, ,, kernel ,, ,,
,, ,, oil ,, ,,

II. In 1924 a new palmery of 100 acres was planted with *Mohei* seed collected in the Experimental Station of Gazi, and with a few seedlings from the Riverbank plantation. The original spacing was 3 × 8 metres, but the 16,640 palms were severely thinned in 1929-32, all palms that proved unsatisfactory as to the thickness of shells and amount of pulp being discarded. Only 2,500 palms are now left in this field, but all are pure *Tenera* or good *Dura* type, and all bear annually a satisfactory number of bunches, themselves of an approved composition.

III. In 1927 the *Regie des Plantations de la Colonie* (Board of Government Experimental Stations) approved of the foundation of a special Selecting Station, at about 3 miles north of Yangambi, for the improvement of Hevea, oil palms, coffee, and foodcrops. A field of 100 acres was planted with 16,000 seedlings of the *Mohei* variety growing in the Gazi plantation, which is devoid of all other varieties of oil palm. The thinning of this palmery started in 1933, and was based on the annual crop given by each tree and the composition of its fruit: only 6,131 palms were left.

IV. In 1929-30 a fourth *Mohei* palmery, covering 210 acres, was planted with Riverbank seeds. It consequently is a second generation of the original palms whose seeds were planted in 1922. This new palmery, however, contains trees which may not be true to type as at the time the seed was collected the Riverbank plantation contained a few palms whose purity in respect of *Mohei* characters had not then been proved.

V. Another field of 25 acres was also planted in 1929-30 with seed of uncertain parentage from the Riverbank plantation, but these seeds were gathered on the palms whose fruit had a high percentage of oil in the pulps. Moreover, in 1933, all the trees whose annual crops of bunches were less than 120 kilos (264 lb.) per tree were uprooted. This palmery is now a second generation of Riverbank *Mohei*, improved as to the percentage of oil, and a first generation of *Mohei* improved as to the annual yield.

Recent reports issued by M. A. Beirnaert, Director of the Selecting Station, give the following details.

By November 1936 the total number of oil palms whose fruits had been examined as to the proportion of pulp, shell,

and kernel was 63,460. The only palms left standing were those whose fruit showed a satisfactory composition; the number of these selected trees fell to 41,000 in 1933, and to 22,200 in 1936.

A special selection has been made of the best palms for the production and sale of improved seed: it numbers 661 palms. The number of seeds sold during the last eight years was as follows:—

Selected seed from Mohei palms of unknown origin . . .	2,198,000
Improved seed from heavy cropping Mohei	1,836,200
Selected seed from cross fertilisation between heavy cropping Mohei	3,033,900
	7,068,100

These seeds were mostly planted on native farms at the rate of 500 to 600 grams per hectare (about $\frac{2}{3}$ lb. per acre).

A large number of cross fertilisations were done in 1934 and 1935, and some more in the beginning of 1936, the total number of these crossings being now 6,450, the collection of pollen and the crossings being made under closed bags.

The variety produced at Yangambi is a *Tenera*, distinguished by a large percentage of oil and a thin but strong shell which can withstand the pressing process.

The Selecting Station has now 30 mother trees having an average annual production of 30 to 40 kilos of oil per tree. The seedlings obtained from these mother trees by crossing or by auto-fertilisation are planted in genealogical fields, whose extent in October 1936 was 70 hectares (175 acres).

On a number of 2,000 palms whose individual and annual yield of bunches was weighed, and whose average yield amounted to 57 kilos (125 lb.), the following figures were obtained:—

	Bad yielders.	Moderately good yielders.	Good yielders.	Very good yielders.
Number of palms . . .	1,129	641	149	15
Percentage on total number .	58·2	33·2	7·7	0·8
Or approximately . . .	$\frac{6}{10}$	$\frac{3}{10}$	$\frac{1}{10}$	

Special care must be taken to eliminate the palms that produce a small number of heavy bunches (20-29 kilos. on 8- or 10-year-old trees). *The difference between good and bad*

yielders resides not in the weight of the bunches, but in their number. Among 2,000 Yangambi palms bearing an average of 19 bunches a year, four-fifths were good yielders, whereas among the palms which bore very heavy bunches (weighing more than 14 kilos) two-thirds of the number were bad yielders.

The best palm variety obtained in Yangambi is known as the *Yangambi-type*, and differs from other *Tenera* palms by a larger kernel, a thicker shell, a greater quantity of pulp, and an ovoid shape. According to the latest information, the yield of palm oil is expected to rise well above 3 tons per hectare.

TANTALITE DEPOSITS OF SOUTH-WESTERN UGANDA

In an article on the "Production, Utilisation, and Marketing of Columbite-Tantalite Minerals," published in this Bulletin, 1936, **34**, 348, the occurrence of minerals of this type in Uganda was mentioned and analyses made at the Imperial Institute of samples from that country were placed on record. The deposits of tantalite in the south-western part of the Protectorate have recently been investigated by the Uganda Geological Survey, and the results are incorporated in a report by A. D. Combe, Field Geologist, which has been transmitted through the Director of the Survey to the Colonial Office. The Imperial Institute has been kindly furnished with a copy of this report from which the following account of the occurrence and development of the deposits has been taken.

Deposits of tantalite occur at several places both in the south-western part of Ankole and the south-eastern part of the Kigezi District. Some of the occurrences have been known for several years, but they have only recently been worked, as there was an uncertainty in marketing the mineral and of ascertaining its value. Moreover, some of the deposits contain tinstone and tantalite together, necessitating the separation of the two minerals by a magnetic process.

The tantalite-bearing veins are of an unusual type, and, though differing in detail, they are of a generally similar

character. They occur in the same area as the tin deposits, in phyllites, mica-schists and quartzites of the Karagwe-Ankolean System, not far from intrusive masses of porphyritic biotite-granite. The mineral also occurs in the rubble adjacent to, and on the slopes below, the veins, where it is found as angular fragments, worn and unworn crystals, and in lumps up to several inches across.

It seems that the production of tantalite, unless rich patches are frequently found, will be variable and will not greatly exceed that of the past few months. The detrital deposits, unfortunately, are of a limited extent, and only a relatively small quantity of tantalite will be won from them. It is highly probable, however, that other tantalite-bearing deposits will be found, and, in fact, two new localities have just been reported.

Description of the Deposits

Kakanena

This appears to be the most important of the deposits so far found. It lies immediately south-east of the highest point of Kakanena hill (height 5,617 ft., long. 30° 05′ 23″ E., lat. 0° 58′ 39″ S.) in south-western Ankole, and was discovered during the latter part of 1933, although no work was done until early in 1936. The deposit consists of a quartz vein varying from 20 to 40 ft. wide and from 350 to 400 ft. long. It strikes north-west and south-east, cutting, nearly at right angles, across the strike of the highly tourmalinised schistose phyllites. The dip is about 80° to the north-east, while the enclosing rocks stand vertically or nearly so. A coarse interlocked aggregate of muscovite occurs as scattered bunches and masses, varying from a few inches to 6 ft. across, and as irregular bands along the edges, especially on the north-eastern side of the deposit. Tantalite occurs in the vein-quartz as erratically distributed grains, blebs, and crystals up to 2 in. in length, which are not confined to any particular part of the mass, much of the quartz being barren. Most frequently, however, it is found between the quartz and the coarse muscovite of the included aggregates or in the bands along the edges. Usually there are only occasional grains and small crystals of tantalite in the coarse muscovite.

At the southern end of the deposit, on each side of the

quartz, a kaolin-like aggregate of very fine sericite with coarse muscovite forms a mass varying from 4 to 12 ft. wide, and in places, between this and the quartz, there are irregular lenses of coarse mica. Between the quartz and the lenses of muscovite a seam several inches across was rich in tantalite, which occurred as coarse crystals, blebs, and lumps as much as 4 in. long and 3 in. wide. The seam was about 50 ft. in length and was mined to a depth of 30 ft. which was as far as it was possible to work safely under the existing conditions. Work will be resumed and the seam followed downwards in an open working as soon as the necessary preparations have been made. It is believed that more than 7 tons of tantalite were recovered from the seam, which, however, is not likely to persist far downwards, although other seams may be found.

Tantalite also occurs in the rubble about the vein and in the detritus on the north-eastern and south-eastern slope of the hill, but these deposits are of a limited extent and will not take long to remove. The quantity of tantalite in them is not known, but rich patches probably exist. So far it is not known whether it will be necessary to mine the whole of the vein and sort out the waste material in order to obtain the tantalite, or whether the mineral will occur in such a manner as to make it possible to leave much of the barren quartz in place. Mr. Combe is of the opinion that it will be necessary to excavate most of the material in order to obtain the irregularly distributed patches of tantalite. The deposit is being further prospected by digging trenches across the outcrop, and, if results prove favourable, a concentration plant will be erected. Up to the end of November 1936 about 15 tons of tantalite has been produced and sold to a well-known firm of metallurgists in England. The deposit is being worked by Mr. J. Gastrell under a tribute agreement with the finder, Mr. L. Arcari.

Along the Kakanena line of hills and on the parallel ridge to the south veins and irregular deposits of quartz are numerous and tantalite will probably be found associated with some of them.

Dwata

The Dwata deposit (height 5,500 ft., long. 30° 20′ 21″ E., lat. 0° 56′ 04″ S.) lies about 5 miles north-north-west of the

Mwirasando tin mine, in southern Ankole, and was discovered at the beginning of 1935 in the prospecting area granted to Kagera Mines, Ltd. It consists chiefly of an aggregate of very fine scales of white sericite with coarse muscovite in varying proportions, together with quartz in irregularly distributed blebs, lenses, and masses from a few inches to more than 6 ft. across. The deposit varies from 5 ft. to about 35 ft. wide, and is more than 430 ft. long. For about half its length the vein, which appears to dip vertically, trends south and then swings to S. 25° E., cutting the enclosing quartzites obliquely. It has been explored by surface trenches and by two adits driven along its strike, one adit being 270 ft. long and the other, which is being continued, 434 ft. long. The first adit is about 50 ft. below the highest part of the outcrop, the second being about 100 ft. below the other and 480 ft. to the south.

So far as the deposit has been explored, the distribution of the tantalite is extremely irregular, only an occasional grain or crystal of the mineral being exposed in the veinstuff. The mineral occurs chiefly in the fine sericite, as blebs and also as tabular and stout crystals up to 3 in. long. Two tantalite-rich patches were found in the first adit, from which about 1½ tons of the mineral was recovered. They occurred near the eastern wall of the vein, but as the deposit has not been systematically explored by cross-cutting at regular intervals, it is not known whether the mineral is confined to any particular part. It is stated that the second adit is being driven in order to find out whether the rich patches in the adit above, which in themselves are small, continue downwards. At the present time, however, the deposit is apparently too low grade to be worked profitably, although further work must be done before a definite conclusion can be reached. The tantalite so far recovered has been sent to the head office of the Billiton Co. at The Hague.

The tantalite-bearing detrital deposits on the slopes adjacent to the vein are of low grade and limited extent. Other deposits have been found recently not far from Dwata.

Ruhuma

The Ruhuma deposits (height 5,200-5,400 ft., long. 30° 12′ 30″ E., lat. 1° 12′ 30″ S.) lie about 1¼ miles north-north-west

of Kamwezi, in the south-eastern part of the Kigezi district. They were discovered several years ago, and a small quantity of tantalite and tinstone has been recovered. The deposits consist of quartz veins with irregularly scattered bunches of coarse muscovite, and also of very fine sericite and a kaolin-like material with varying proportions of coarse muscovite and quartz.

The veins form a group in a belt measuring several hundred yards across and about 500 yards long. The strike ranges from N. 25° W. to N. 80° W., while the dip is from 70° to 80° to the south-west. The length of the veins ranges from 30 ft. to about 150 ft. and the width from 1 to 8 ft. with an average of about 2 to 3 ft. The enclosing rocks are highly tourmalinised schistose phyllites striking N. 65° E. and dipping 70° to 80° north-westwards. Tantalite is present in small quantities in most of the veins, which, however, have not been properly investigated. In the vein at present being worked the tantalite is found in irregular distributed patches. The material recently obtained is said to be of very high grade, the percentage of columbic oxide being low. The vein is being worked by Mr. M. Nuti, who has arranged to sell the output to a London company.

It is considered unlikely that the Ruhuma veins will persist downwards to any considerable distance. It is impossible to make even a rough estimate of the amount of tantalite that will be won, although the production is not likely to be more than a few tons per month, unless rich patches are discovered frequently. Some of the deposits carry tin and tantalite, while others carry only tin.

NOTES

Reception at the Imperial Institute.—Their Royal Highnesses the Duke and Duchess of Gloucester were present at a Reception held at the Imperial Institute on Monday, May 3, 1937, to welcome Delegates from the Overseas Empire Legislatures to the Conference of the Empire Parliamentary Association. Captain the Rt. Hon. Euan Wallace, Secretary of the Department of Overseas Trade and President of the Board of Governors, and Mrs. Wallace, with Sir Harry Lindsay, Director of the Institute, and Lady Lindsay, received the guests.

The Delegates and a number of other visitors representing Overseas Empire Governments at the Coronation were presented to Their Royal Highnesses by Sir Howard d'Egville, Organiser and Secretary of the Empire Parliamentary Association, and the President of the Board of Governors presented the Chairmen of the Advisory Councils and Committees of the Institute.

A large number of prominent United Kingdom and Overseas Government officials, together with representatives of important industrial and commercial interests, accepted invitations to the Reception, which undoubtedly afforded a useful opportunity for bringing to the notice of the visitors the extensive improvements and additions to the Exhibition Galleries since their visit to the Institute in connection with the Reception held in 1935.

The Exhibition Galleries.—A new exhibit has been added, with the aid of the Burma Corporation, Ltd., to the Burma Court, illustrating the ores and metallurgical products of the famous Bawdwin mine of Upper Burma. Under the title " From one mine, many metals," the story of the mine is told commencing with specimens of typical silver-lead-zinc, copper and nickel ores and passing on by means of samples and clear photographs through the operations of milling, concentrating, smelting, desilverising, retorting, cupelling, and moulding which lead to the production of refined silver and refined lead. At the appropriate stage in the story the production of zinc concentrates, copper matte, nickel speiss, and refined antimonial lead is also visually recorded.

In the Malaya Court a new exhibit shows the utilisation of the mangrove tree. Starting with a view of a mangrove swamp and a piece of tree trunk, branches diverge to tell, by means of photographs and specimens, three different stories recording the production of charcoal, firewood, and mangrove cutch. Another newly arranged exhibit in the Malaya Court illustrates in story fashion the mining of tin, its preparation, refining, and many of its everyday uses.

To the East African Court a new exhibit has been added, with the co-operation of Messrs. Wrights Ropes, Ltd., to illustrate the utilisation of Tanganyika sisal for the manufacture of ropes and twines. This exhibit also is arranged in " story " form, and shows by means of photographs and specimens of the material at different stages the various processes and the machines employed to convert the raw fibre into finished cordage.

The Sierra Leone Court has received two new dioramas, one to illustrate the iron ore industry and the other the diamond industry. Both these were constructed in the Imperial

Institute Studio. A photograph of the diorama of the iron ore industry is reproduced in Plate I, and the account of the method of mining, as given in the descriptive label, reads as follows :—

Sierra Leone

Iron Ore Mining

"The iron ore occurs in hills covered with trees, which are removed as mining operations progress. A hill is worked in terraces, one of which is shown in the foreground of this diorama.

"On top of the bank, in the middle distance, drillers are making holes in the loose rock, preparatory to blasting. The drilling is accomplished by means of an iron rod about 16 ft. long, which is worked by hand in between the natural cracks in the rock to a depth of about 8 to 9 ft. The drillers have handy a supply of water, in a bottle, to aid the penetration of the rod. After the hole has reached a suitable depth an explosive is inserted, and on discharge a crumbled mass of iron ore falls to the foot of the bank.

"After the large pieces have been broken to a convenient size for handling, the ore is loaded into steel wagons for transport. In the middle foreground workers are seen engaged in this operation. On the left a European official is giving instructions to a native foreman. On the extreme left are wagons filled with ore being clipped to a main incline haulage for transport to the loading bank, where the ore is either transferred direct on to the railway or given a preparatory washing and screening.

"On the extreme right is a heading which leads to another terrace where similar mining is going on. Successive terraces are made according to the contour of the hill, each terrace being connected with a haulage for the removal of the ore. The terraces are worked one after the other until all the ore is exhausted."

The following is the text of the descriptive label for the diamond mining diorama.

Sierra Leone

Alluvial Diamond Mining

"The diamond deposits are found underlying the valleys of rivers and streams. Before mining operations can commence it is often necessary to divert the course of a stream or river so that the area may be worked. In this diorama a river so diverted is seen on the extreme left.

"In the distance is Konkowako Hill, a prominent landmark, and across the stream on the left is a native village.

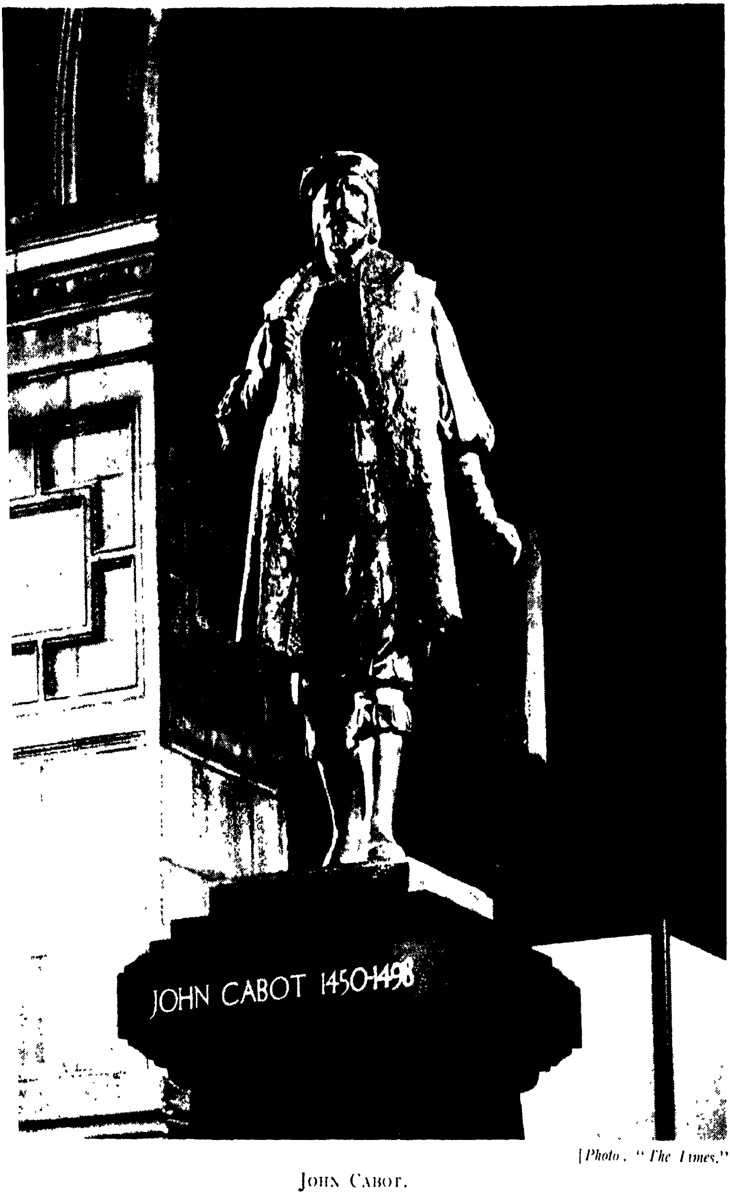
PLATE I

SIERRA LEONE: IRON ORE MINING

Reproduced from a Diorama in the Exhibition Galleries of the Imperial Institute

[facing page 186

PLATE II



[Photo. "The Times."

John Cabot.

A Statuette in the Newfoundland Court of the Exhibition Galleries of the Imperial Institute

On the right of the Hill are the red-roofed buildings of the main camp of the African workers, whilst on a granite hill on the extreme right are the bungalows of the European officials in charge of the mine.

"In the middle distance natives are engaged in taking cuts across the width of the valley and removing the top-soil, or overburden, to expose the diamond-bearing gravel. This gravel is being dug up and loaded into tip-wagons on rails for transport, by means of an endless rope haulage system, to the treatment plant (seen in the foreground on the right). The gravel is introduced into the plant by means of a conveyor belt, and then proceeds by gravity through the different phases of treatment. As it passes through the plant it is well washed and carefully sized, each size is subsequently concentrated forming a product containing diamond. The concentrates are then passed with water over inclined grease-tables, to which any diamonds that may be present adhere. The diamonds are recovered by hand-picking.

"The tailings or waste material from the washings are transferred from the plant to the worked-out area to fill in the ground, which is left level."

Progress has been made with the new South African Court, the most important recent addition being the fine series of coloured transparencies received from the Railways and Harbours Board of South Africa. These transparencies, each measuring 18 in. × 20 in., have been carefully and accurately hand-coloured on a photographic basis, and when illuminated they give a striking and life-like impression of the scenes represented. Under the caption, "The Sunshine Route, a tour through South Africa," they have been arranged in specially made fittings, furnished with suitable means for illumination, and painted dull black in order to emphasise the colouring of the pictures. The "tour" starts on the north side of the Court near the diorama of Cape Town and passes through Cape Province to the Orange Free State, the Transvaal and Natal, and is continued down the south side of the coast from Natal back to Cape Town, terminating on the opposite side of the Cape Town diorama. Material is now being assembled for "story" exhibits illustrating the industrial uses of South African gold and diamonds. The diorama of the wool industry of the Karroo has been returned to the South African Government for display at the Paris International Exhibition which opened on May 25.

Two new "story" exhibits have recently been installed in the Canadian Court. One of these, under the heading, "Wheat, from grain to flour—a 'Straight-run' by Spillers, Ltd.," tells by means of photographs and specimens arranged in sequence, and connected by guide lines and arrows, the

story of the milling of flour from selected Canadian hard spring wheat. The other new Canadian exhibit tells the story of Canadian nickel and some of its every-day uses. By means of photographs the mining and metallurgical processes of nickel extraction are shown, together with specimens of the ore and pure nickel. As examples of the everyday uses of nickel the component parts of a wireless valve and a series explaining how a tablespoon and fork are prepared are exhibited together with composite photographs showing the percentages of the nickel output employed for various purposes such as nickel alloy steels, nickel copper alloys, nickel plating, pure nickel, nickel silver, nickel cast iron, heat-resisting alloys, and miscellaneous uses. Actual specimens of these products in use in familiar articles of every-day use are also exhibited. The diorama of nickel mining has been lent from the Court for display in the Paris International Exhibition.

In addition to the statuette of John Cabot (see below), the Newfoundland Court has received a number of new window transparencies which have been fixed in the windows on both the north and south sides of the Court. These are arranged in a definite sequence so as to illustrate a tour through the country, and camping and fishing scenes. Apart from their attractive appearance and their interest to the casual visitor these transparencies serve the guide lecturers in the place of lantern slides to illustrate the talks given to school parties in the Court.

John Cabot.—A statuette in bronze of John Cabot, the discoverer of Newfoundland, has been placed in the Newfoundland Court in the Exhibition Galleries of the Imperial Institute (see Plate II). It is the work of Mr. Herbert H. Cawood and has been kindly presented by Sir Edgar Bowring, K.C.M.G., the first High Commissioner in London for Newfoundland and a member of the Board of Governors of the Institute. The statuette is the first addition since the decision was made to install in the Institute Galleries the figures of Empire builders of outstanding genius, each to stand in the Court of the country with which his life's work was mainly identified. Before this decision was taken there already existed statuettes of Lord Clive, Captain Cook, Cecil Rhodes, and Burke and Wills, the Australian explorers. Others in preparation include one of Johann Van Riebeeck, the founder of Cape Colony, and another of Sir Stamford Raffles, who founded the British Settlement at Singapore.

The following short account of the life of John Cabot is displayed with the statuette.

"John Cabot (Giovanni Caboto) was born in Genoa in 1450, and moved, in 1461, to Venice where he became natural-

ised in 1476. On one of his journeys he visited Mecca, then a great market for the exchange of goods between East and West, and watched the caravans arriving from north-eastern Asia. He argued that, the world being a sphere, a quicker and shorter route to Europe would be across the western ocean. In order to prove his theory he came to London about 1484, and having interested merchants in his scheme, his first voyage was an attempt to find the 'Island of Brazil,' believed to lie to the west of Ireland. This fruitless search ended in the summer of 1493, when news reached England that another Genoese, Christopher Columbus, had reached the West Indies. Cabot then obtained letters patent from Henry VII, and sailed from Bristol on May 2, 1497, in an attempt to reach Asia by the western route. After 52 days he made Newfoundland and passed the islands now known as St. Pierre and Miquelon, and there he saw schools of cod, which the sailors caught in baskets let into the sea. What is now known as Cape Race was named by him England's Cape.

"In May, 1498, he again sailed from Bristol on his second attempt to find the western route. Of his two ships, one was forced to return by bad weather, but Cabot eventually reached the east coast of Greenland, which he named 'Labrador's Land.' Because of the intense cold, his crew mutinied and he was forced south. Crossing the Davis Strait, he reached Baffin Land, which he believed to be the Asiatic mainland; continuing south he passed the entrance to Belle Isle Strait, which he thought was only an inlet, and assumed that Newfoundland was part of the mainland. He returned to England in the autumn of 1498 and died shortly after his return."

Colonial Visitors.—The following is a list of officers on home leave from the Colonies who have visited the Institute during the three months February to April 1937.

FEBRUARY 1937

R. H. BASSETT, Commissioner, Department of Commissioner for Development of Agricultural Marketing, Ceylon.
D. LEAKEY, Assistant Conservator of Forests, Kenya.
J. M. S. USHER-WILSON, Agricultural Officer, Nigeria.

MARCH 1937

J. V. COLLINS, Government Analyst, Ceylon.

APRIL 1937

Professor N. G. BALL, Professor of Botany, University College, Ceylon.
C. B. BISSET, Field Geologist, Uganda.
J. HEARD, Veterinary Officer, Nigeria.
T. HIRST, D.I.C., A.R.S.M., Geologist, Geological Survey, Gold Coast.
J. H. MACKAY, Assistant Conservator of Forests, Nigeria.
T. McEWEN, Agricultural Officer, Uganda.
E. J. STRUGNELL, Senior Assistant Conservator of Forests, Federated Malay States.
C. W. SWITZER, Assistant District Officer, Uganda.
A. J. WAKEFIELD, Deputy Director of Agriculture, Tanganyika Territory.
Major Sir HUBERT W. YOUNG, K.C.M.G., D.S.O., Governor, Northern Rhodesia.

All Dominion and Colonial officers, as well as private residents overseas, who may be visiting London, are cordially invited to come to the Institute to see our Exhibition Galleries, or to discuss scientific and technical problems in which they may be interested.

The Grading and Marketing of Wattle Bark in South Africa.—In accordance with a resolution passed by the Parliament of the Union of South Africa in 1936 a Departmental Committee was appointed by the Minister of Agriculture and Forestry to enquire into the grading and marketing of wattle bark, and the report of that Committee has now been published (*Union of South Africa, Department of Agriculture and Forestry*; "*Grading and Marketing of Wattle Bark,*" *Report of the Departmental Committee*, Pretoria, 1936).

The reasons for the enquiry were that as a result of the general depreciation of prices for some years growers of wattle bark had been greatly concerned about the future of the industry, and general anxiety had been further increased by the Trade Commissioner's adverse comments on the quality of bark exported to the United Kingdom.

The report points out that wattle bark of the type and quality required by users for tannage, as well as for the manufacture of extract, is still being produced in South Africa, but there is evidence that more bark of inferior quality is now placed on the market than formerly. The increased output of poor quality bark is partly due to many plantations being allowed by neglect to degenerate into the "jungle" state, such plantations yielding at best thin bark of low tannin content. Other contributory causes are the abandonment by many growers of the practice of protecting the bark from rain and weather during drying and storage, and the harvesting of the bark before it has reached maturity. One improvement which should ensure the marketing of a better product can be effected by the growers sorting their bark at the time of stripping and suggestions are made as to the different classes into which it should be graded.

Wattle bark is exported from South Africa in the form of chopped bark, ground bark, or as extract. Growers usually sell their product to the extract factories, of which there are four in the Union, or to millers who submit it to the necessary treatment prior to export. This treatment consists in passing the bark either through a chopping machine or through a grinding mill and the subsequent pressing of it into bales weighing about 200 lb. each.

As regards wattle bark exported from South Africa, the Departmental Committee considered that in the interests of the industry some system of standardisation must be intro-

duced. Possible bases of grading of the bark for overseas trade were reviewed. Grading on the results of chemical analysis was not deemed to be practicable on account of the cost and the difficulty of sampling compressed bales of chopped or ground bark at the port to obtain a representative portion. They therefore favoured the system of grading by sight examination, and recommended the following grades which they considered would meet the varying requirements of the different markets.

Mark.	Grade.	Standard.
NCP	Natal Chopped Prime	Extra-heavy or thick, well-dried, mature bark of good colour on surface and on fracture.
NCA	Natal Chopped Average	Well-dried, mature bark of average thickness and colour.
NCF	Natal Chopped Fair	Well-dried, thin, mature bark of good colour; also bark of average thickness but indifferent colour.
NCS	Natal Chopped Special	Bark of variable colour and thickness; not conforming to any other class.
NGA	Natal Ground Average	Well-shredded bark of good colour and with minimum of dust.
NGF	Natal Ground Fair	Ground bark not conforming to the foregoing description.

The introduction of this system of standardisation contemplates (*a*) the registration of exporters of bark; (*b*) the grading of all bark intended for export in conformity with the official standard; (*c*) the inspection by Government of all bark being exported at Durban and East London; (*d*) the appointment of an official inspector at Durban—the Forest Office at Kingwilliamstown to be responsible for East London; (*e*) the payment of an inspection fee not exceeding 1s. per ton on each consignment of bark exported; (*f*) the registration of each exporter of a distinctive brand under which he is to market the bark exported by him; (*g*) the marking of each package of bark with the registered brand, port, and country of destination, the class mark of the bark, and a serial number for each consignment; (*h*) the determination by the inspector of the standard of each consignment and the issue of a certificate in respect thereof; and (*j*) the passing of legislation to give effect to the above requirements and authority for promulgation of the necessary regulations.

The grading of wattle bark extract is not considered necessary as this product is exported under a certificate guaranteeing its tannin content as determined at the factory.

The Minister of Agriculture and Forestry has accepted these recommendations. In order to ensure the successful initiation of this system of grading he has directed that the services of officers with special knowledge of the subject be

made available to advise growers on the methods of cultivation and harvesting of wattle bark and to assist growers and exporters in regard to grading. Steps are being taken to draft the necessary regulations required to give effect to the proposed scheme. Before promulgation, however, the grades, grade marks, and standards laid down are to be discussed with the overseas trade, and it is hoped that for this purpose the Director of Forestry, as Chairman of the Departmental Committee, will personally be able to visit Europe in the near future.

One of the three members of the Departmental Committee, namely, A. P. Van der Post, Assistant Chief, Division of Economics and Markets, registered in a minority report his disagreement with the recommendation of a system of grading based upon sight examination, as he considered the gradation between the different qualities so small as to render the working of the system difficult. In addition, he pointed out that the requirements of the different markets varied and that exporters were in the best position to know these requirements; that it was necessary to maintain for each market a standard equal to the best bark it required; and that the introduction of a system of grading should interfere as little as possible with existing trade usage. He, therefore, recommended that specimen standard samples of the different classes of bark exported to the different countries be prepared and a description of each class drawn up. Exporters should be invited to co-operate with the Department of Agriculture and Forestry in this work. Bark should only be exported under a definite class mark corresponding to one or other of the classes represented by specimen samples. Each exporter must be registered with the Secretary of Agriculture and Forestry, and must also register a brand under which to export the bark.

The Experimental Cultivation of Oil-yielding Plants in the Irish Free State.—An investigation has been completed by Professor J. Reilly and Denis F. Kelly, of the Department of Chemistry, University College, Cork, to determine the properties of the fatty oils obtained from the seeds of several oil-bearing plants when grown in the Irish Free State. The ultimate object of the investigation is to demonstrate whether it is possible to displace such oils as linseed and rape prepared from imported seed by the home-grown products or to replace certain imported oils such as cotton-seed oil by those obtained from Irish-grown sunflower or poppy seed. The results of this investigation have been published in a preliminary report entitled "Oils from Irish-grown Plants." (*Agricultural Bulletin No. 4, Cork University Press Publications*, 1937.)

The authors have shown that the cultivation of linseed,

rape, mustard and poppy seed in the South of Ireland is feasible and that the oil content of the seeds and the properties of the oils are normal, as were also those of hemp and sunflower seeds and oils, but in the last two cases the results of the field trials were inconclusive though they gave every indication of success. As far as linseed is concerned it is estimated that about 5,000 acres will have to be put under this crop in order to furnish sufficient oil to equal the annual imports into the country, which were about 1,700 tons in 1934 and 1,300 tons in 1935.

According to some authorities sunflower-seed oil can well replace cotton-seed oil in the edible fat and soap industries in the Irish Free State. The preliminary field experiments showed that poppy seed is relatively easier to produce than sunflower seed, whilst it has the further advantage of a higher oil content. More work is considered necessary, however, before a definite opinion can be expressed on the possibility of replacing cotton-seed oil by poppy-seed oil, and the suggestion is made that it may be found desirable to submit both sunflower-seed and poppy-seed oils to a partial hydrogenation to render them more suitable substitutes for cotton-seed oil. To furnish sufficient oil to replace the amount of cotton-seed oil imported into the Irish Free State (about 2,300 tons in 1934) about 7,000 acres would have to be devoted to the cultivation of sunflower seed or 5,000 acres to that of poppy seed.

In the event of oil seeds being cultivated on a commercial scale and crushed locally, oil-cakes would be obtained as a by-product and should tend to reduce the quantities imported.

Amongst other oil seeds, trials have been started with soya beans and *Mercurialis annua*, whilst small trials are also to be undertaken with *Madia sativa*, *Glauceum luteum* (yellow horned poppy), and *Camelina sativa* (German sesame).

In addition to detailed descriptions of the field trials carried out with the various seeds tested the *Bulletin* contains much useful general information relating to the botanical source, countries of production, uses and characteristics of the oils, methods of cultivation and yields. Tables are also given showing the quantities of the seeds under test, which are grown in Europe. In the section on linseed reference is made to the results of cultivation trials made with that crop in England.

The field trials were carried out on a very small scale, the plots being less than an acre, and the yields obtained cannot be used as data from which to calculate the returns to be expected from commercial plantings. The preliminary work has indicated that certain oil seeds can be successfully grown in the Irish Free State, but the authors have wisely refrained

from expressing an opinion on the economic side of the question. These small tests, they point out, must be followed by further trials to demonstrate the yields to be expected in practice and to determine the best varieties to cultivate. When this information has been obtained, large-scale experiments should follow.

Prior to the experiments under review with certain oil seeds, work had been carried out by the Department of Chemistry, University College, Cork, on growing in the Irish Free State plants yielding essential oils, such as lavender, peppermint and dill.

The authors in carrying out this investigation on the experimental cultivation of certain oil seeds in the Irish Free State have rendered a very useful service by indicating the possibility of the replacement of a proportion of the imported oils and oil seeds by home-grown products. The results of their preliminary work are such as to warrant further trials on a much larger scale.

Cacao Shell as a Foodstuff for Cattle.—The testas of the cacao seeds or "beans" used in chocolate and cocoa manufacture form a by-product of the industry known as "cacao shell." Analysis shows this to be similar in composition to good meadow hay, though of somewhat higher food value, and containing, in addition, about 1 per cent. of theobromine. Knapp and Coward (*Biochem. J.*, 1935, **29**, 2728) have shown that cacao shell may also be rich in vitamin D, derived from yeasts containing ergosterol, which develop, during the fermentation process, in the pulp surrounding the beans. The ergosterol is converted to vitamin D during drying in the tropical sun.

This special feeding value of cacao shell has been the subject of investigation in feeding trials. Kon and Henry (*Biochem. J.*, 1935, **29**, 2051) were able to demonstrate that, under winter stall feeding conditions, cows fed with 2 lb. of cacao shell daily for a month showed an increase in the vitamin D content of their milk and butter from winter to summer level.

Golding and Burr (*Agric. Progr.*, 1937, **14**, 44) have now investigated the effect of feeding cacao shell to cows on the yield, fat percentage and solids-not-fat percentage of their milk. Two experiments were carried out. In the first, four cows were used, two as experimental and two as control. The cows were not put out to grass, and received a rationed diet of mangels, hay, and hominy chop, together with an allowance of concentrates based on individual milk production. The two experimental cows received, in addition, a ration of cacao shell which was gradually increased up to 2 lb. daily and continued at this level for over a month, adjustment being

made in the amount of concentrates fed over this period. No difficulties or adverse symptoms attended the feeding of the shell. At each of the two daily milkings the milk was weighed and a sample analysed.

In the second experiment two groups of seven cows each were taken. The normal feeding practised on the farm was not altered, summer diet being introduced during the experiment. The hay fed in the earlier stages and the grass fed latterly were not rationed. During the first half of the experiment cacao shell was fed, in addition, to one group of cows, the second group acting as control, while in the latter half the second group of cows received the shell and the first provided the control. The milk from each group was collected, thoroughly mixed, and a representative sample analysed.

In both experiments an increased percentage of fat was apparent in the milk from cows receiving the cacao shell. The increase obtained in the second trial was shown to be statistically significant. The total yield of milk and the percentage of solids-not-fat were not appreciably affected in the first experiment, but in the second a slight increase in milk-yield was noticeable in cows fed with the shell.

Similar results to these have been obtained by other workers, and in no case has a daily ration of about 2 lb. of cacao shell been found to have ill-effects. Cases have however been reported where excessive quantities of the shell have been injurious.

Sarcoptic Mange in Goats.—Until recently very little information has been available correlating skin diseases in living animals with the resulting defects in finished leather. At the instigation of the Imperial Institute Advisory Committee on Hides and Skins, an investigation was started, about two years ago, by the British Leather Manufacturers' Research Association, working in co-operation with the Imperial Institute and with veterinary officers in various parts of the Empire. As a result, a number of skins from animals affected with different diseases have been sent, notably from the African Colonies, and examined microscopically, both in the raw state and after making into leather.

A report on some of this work has now been published by Miss Mary Dempsey and Dr. Madge E. Robertson (*J. Int. Soc. Leath. Chem.*, 1937, **21**, 196) dealing with goat skins derived from animals suffering from Sarcoptic mange. This disease is caused by small mites, scarcely visible to the naked eye, which burrow their way beneath the skin of the goat, feeding on the cells in the deeper layers of the epidermis. The disturbance and irritation set up cause an

exudation from the affected cells, which results in the formation of scabs and scales.

The report is based on the examination of seven goat skins sent at the request of the Advisory Committee by the Director of Veterinary Services, Tanganyika Territory. All the animals concerned had been badly affected with mange, and had received treatment, but only two appeared to have recovered completely. Of the remaining five, two still showed generalised mange at the time of slaughter, while the other three were only partially cured.

After examination in the raw state, the skins were made into glacé kid, and were further examined in the finished condition and at an intermediate stage, " in the blue " after chrome tanning.

The tanner who reported on the condition of the skins found that the disease tends to give the leather a coarsened grain, with " mange marks " on badly affected patches. Skins which have been infected for any length of time give leather of little value, but in cases where curative treatment is successful, and previous infection has not been of long duration, quite a saleable leather may be produced. It must be noted, however, that the skin does not always return to normal condition when an animal is cured, as irreparable damage may already have been done.

Microscopical examination showed that in cases of severe infection the hair follicles are almost completely obliterated, and the grain consists of a more or less uniform compact fibrous tissue, characterised by irregular papillate protuberances on the surface, which are especially prominent " in the blue " stage, before the finishing process. As a result of the general weakening of the animal, which must eventually arise from severe infection, the skin as a whole suffers in quality, and this is particularly noticeable in the open and disorganised structure shown by the corium tissue, a region which is not actually reached by the mites.

Occurrence of Selenium in Soils and Crops.—The fact that selenium occurs widely distributed in soils and vegetation, especially in the United States, with consequent danger to stock and possibly to human life, has already been noted in this BULLETIN, 1936, **34**, 368. The work in connection with this subject has been continued and forms the basis of a recent report. (" Selenium Occurrence in Certain Soils in the United States with a Discussion of Related Topics. Second Report," by H. G. Byers, *U.S. Dept. Agric. Tech. Bull.*, No. 530, Dec. 1936).

It has now been proved that large areas of arid land containing sufficient selenium to produce toxic vegetation exist

in parts of Nebraska, South Dakota, western Colorado, western Kansas, and Montana. A very considerable number of humid soils from a wide variety of sources in the United States were also examined, but only one sample was found to contain as much as one part per million of selenium.

A close relationship is stated to exist between the selenium content of the soil and that of the parent material from which it was derived. Up to the present the parent material which has been shown to be associated with toxic soils appears to be limited to the lower portion of the Pierre and the upper portion of the Niobrara formations of the Upper Cretaceous shales (and the corresponding formations in other localities under different names), although it is not asserted that toxic conditions are strictly confined to these formations. The fact that these shales are by no means peculiar to the United States makes the problem one of world-wide importance in arid districts.

Evidence indicates that irrigation with adequate drainage tends to reduce the selenium content of the soil and that if the irrigation water contains sulphates, the presence of which has previously been shown to exert an inhibitory effect on the absorption of selenium by plants, the selenium content of the vegetation is also diminished.

No close relationship can be shown between the quantity of selenium in the soil and that absorbed by individual plants. The results obtained are believed to indicate that the differences found between these quantities are due, not only to variations in the sulphate content of the soil, and possibly to the influence of other soil constituents, but also to the existence of the selenium in different forms of combination, the absorption of which varies.

One of the more serious aspects of the occurrence of seleniferous soils lies in the fact that even when the amount of selenium absorbed by plants growing on such soils is only sufficient to cause slight dwarfing without other injury, the plants may still contain enough selenium to be toxic to animals grazing on them. ("Toxicity of Selenium to Plants and Animals," by A. L. Martin, *Amer. J. Botany*, 1936, **23**, 471-483.) In other words, selenium is more poisonous to animals than to plants, although where the animals are free to choose, they usually appear to avoid the seleniferous portion of the vegetation even when it is of normal appearance.

Use of Dunite for Improvement of Superphosphate Fertilizer.—In order to neutralise any excess acidity and to improve the physical properties of superphosphate, additions of lime or magnesia are sometimes made. The use of magnesium silicate (olivine) in the form of the basic rock dunite for this

purpose has recently been reported. ("Die Anwendung von Dunit zur Verbesserung der Eigenschaften der Superphosphate," by D. W. Druschinin, *Z. Pflanzenernähr., Düngung Bodenk.*, 1936, **45**, 303-5.)

The finely ground dunite was added to each of three superphosphates to the extent of 8 to 9·5 per cent. of their weights. It was found that this quantity served to neutralise the free acid, and also brought about a reduction in the moisture content and improved the physical properties. At the same time the percentage of water-soluble phosphoric acid was decreased, but as the reactions set up apparently lead to the formation of magnesium phosphate and colloidal silica, the percentage of available phosphoric acid was not reduced.

Trials on different soils showed that the superphosphates with dunite added gave higher yields than equivalent amounts of superphosphate alone. These results are attributed to the better distribution of the phosphoric acid in the mixtures, and to the presence of available magnesia and of colloidal silica.

Strontium Minerals.—A second edition of the Imperial Institute monograph on *Strontium Minerals*, by E. H. Beard, B.Sc.(Lond.), was issued on April 21 (Royal 8vo, boards, 33 pp., price 1*s.* 6*d.*). The work is prepared on the same lines as others in the well-known series of economic reports on the Mineral Industry of the British Empire and Foreign Countries, and surveys the whole subject of occurrence, winning and treatment, industrial uses, world production, marketing and prices of strontium minerals.

Among the salient facts presented, it is pointed out that for many years the British Empire has been the world's most important source of strontium, the naturally occurring strontium sulphate or celestite deposits of the Bristol district, Gloucestershire, constituting in normal times almost the only economic occurrence of this mineral. Important deposits of strontianite, or natural strontium carbonate, occur in Westphalia, Germany, but production has been seriously curtailed during recent years owing largely to competition with English celestite. Although in the past, the bulk of the English supplies has been shipped to Germany for the manufacture of strontium compounds, some of which were later imported into the United Kingdom for consumption, attempts are now being made to establish a strontium salt industry near Birmingham.

Strontium compounds are put to a variety of uses, especially in the beet-sugar industry; in the manufacture of fireworks, flares, torches, and signals; as fillers in the seals of electric batteries, in water-paint distempers, asphalt surfacing material and rubber; as "cleansers" for removing sulphur and phosphorus from special steels; as precipitants in the

purification of caustic soda; in certain refrigerators; and in the chemical, pharmaceutical and ceramic industries. Certain of the salts are regarded as essential war materials, particularly for the manufacture of some tracer-bullets and red flares.

A special feature of the work is the review of the literature dealing with the metallurgical uses of the mineral strontianite, and also of strontium metals and alloys. Information on this subject has not been easily available in the past, so that the account now given will doubtless be welcomed by iron and steel technologists. Other features of the report include hitherto unpublished analyses of English celestite recently exported from Bristol Docks, valuable details regarding the registered imports of strontium compounds into the United Kingdom during the period 1934 to 1936 inclusive, and a section on prices of strontium minerals and compounds.

Barium Minerals.—Another monograph, issued on April 30, by the Mineral Resources Department is that on *Barium Minerals*, by J. Simpson, M.Sc.(Durham) (Royal 8vo, boards, 84 pp., price 2s.).

This work is concerned with the uses and occurrences of barytes and witherite in Empire and foreign countries, and the world trade in these minerals. It completely supersedes a much earlier and briefer work, and as is customary in Institute reports, the account of the resources of these minerals forms the greater part of the document, each country being treated separately and accompanied by tables of trade statistics.

In the shorter, introductory part, comprehensive accounts are given of the mineralogy and treatment of the minerals, of the bleaching processes which are used for barytes, and a section is included on world production and marketing. The monograph concludes with a selected bibliography occupying 12 pages.

Barium minerals have a wide range of uses, but by far the most important quantities, both in the form of finely ground barytes and as precipitated barium sulphate (blanc fixe), are used in paint manufacture. Lithopone, which is prepared from barytes, is another substance extensively employed in paints, and an interesting table furnishes a comparison of the typical English, American, Dutch, German, and Belgian products. Other uses for barytes are, for instance, in the heavy muds circulated in wells being drilled for petroleum to prevent outbursts of gas or oil; in X-ray work, both as concrete aggregate and plaster in the walls of the rooms, and in the "barium meal" administered for diagnosis; in the manufacture of Bristol board, fireworks, and certain explosives; and in one of the modern systems of coal cleaning. Witherite is a raw material for the preparation of many barium chemicals,

the uses of which are dealt with in some detail in the publication. The uses of barium metal and alloys are also described.

The United Kingdom occupies a unique position with respect to witherite, being the only commercial producer in the world, and ranks third amongst the countries producing barytes. For some years the output of barium minerals has been expanding in the United Kingdom and the domestic market is no longer dominated by German barytes.

"Barium Minerals" provides a comprehensive account of the world position of these important minerals of which over 700,000 tons were produced in 1935, and should prove of considerable value to chemists, paint manufacturers, and those interested in the study of the mineral resources of the Empire.

The Mineral Position of the British Empire.—The latest publication of the Mineral Resources Department was issued on May 6, under the title of *The Mineral Position of the British Empire* (Royal 8vo, boards, 166 pp., price 4s.).

Commencing with an interesting comparison of the world and Empire outputs of all the more important minerals used in industry in 1929 and 1935, the work surveys the many changes bearing on production during this period, and illustrates by means of graphs the variations in annual output of 12 essential commodities.

All the important metals and minerals except gold clearly show the effects of the great slump which occurred in the intervening years.

The book goes on to discuss briefly the degree of Empire independence in the matter of mineral supplies, according to which it appears that the Empire as a whole is largely dependent on foreign sources of supply for only eight minerals—antimony, borates, molybdenum, petroleum, potash, pyrites, quicksilver and sulphur.

The main body of the book consists of a concise survey of the mineral deposits and mining industries in each Empire country that produces minerals or that is a potential producer, commencing with the United Kingdom, the Dominions and India, and continuing with the Colonies, Protectorates, Mandated Territories, etc.

The procedure adopted in dealing with all these countries is the same throughout. A preliminary statement concerning the mineral industry of the country is followed by a table of output for 1935, and a summary of mineral imports showing countries of origin and exports showing destinations. Each mineral mined or occurring in the country is then dealt with separately, the minerals being arranged approximately in order of importance according to the value of the output. The situation in 1935 is compared with that in 1929, but in

order to make the publication as up to date as possible any later information that is available is also included.

Many interesting facts are brought to light in this little book which covers such a vast field in the space of 166 pages. For instance it appears that in 1935 the Empire produced 86·6 per cent. of the world's nickel and 68·2 per cent. of the world's asbestos, but both these percentages are considerably lower than in 1929. Also, in spite of a greatly increased output of gold, the Empire proportion fell from 72·7 per cent. in 1929 to 58·3 per cent. in 1935, and there have also been considerable decreases in the Empire percentages of chrome ore, manganese ore, and diamonds. On the other hand there have been decided increases in the Empire percentages of copper and lead ore.

The total value of the Empire's mineral output during 1935 approximated to £400,000,000, of which the United Kingdom contributed nearly 42 per cent., the Union of South Africa just over 21 per cent., and Canada 16 per cent., and the striking fact emerges that the value of the coal output of the United Kingdom represents about 37 per cent. of the value of the whole of the Empire output of all minerals.

This moderately priced little book, which is packed with facts and statistical data, should have a wide appeal, not only to those interested in the mineral industry, but to economists and all who are concerned with Empire problems in relation to world affairs.

Gold Recovery by Dry-blowing in Tanganyika.—The Lupa gold-field in the south-west of Tanganyika Territory embraces large areas of detrital deposits, particularly those underlying seasonal swamps or *mbugas*, where the only feasible method of recovering gold in the dry season is to resort to dry-blowing.

The following account of recent developments in this field is based on a statement by Mr. Moraitinis, Managing Director of African Minerals, Ltd., kindly furnished to the Imperial Institute.

For some time the most primitive devices were employed for recovering the gold, but in 1934 a centrifugal type of blower, driven by a small portable petrol engine, was constructed. This apparatus, built on the spot, and necessarily of limited efficiency owing to elementary design, nevertheless gave a very real stimulus to the diggers' activities, but these were still restricted to the working of the richer patches. This departure, however, disclosed the possibility of exploiting the detrital deposits of the Territory by dry methods.

Systematic experimental production operations were conducted in 1936 by African Minerals, Ltd., and the company succeeded in establishing to its satisfaction that with properly

designed equipment the gold could be recovered, by dry methods, in values down to as little as 0·3 gm. per cu. metre (about 1·10 sh. per cu. metre, with gold at 142 sh. per oz.).

Certain areas were selected as being typical of the fields and experimental plant was introduced whenever preliminary prospecting indicated an average gold content of 0·4 gm. per cu. metre.

An experimental plant consisted of three blowing units, each capable of treating 32 cu. metres of gravel in eight hours, with a recovery which was subsequently found to be about 85 per cent., 35 native labourers being employed at each unit, in digging up the gravel, transporting it, and operating the blower.

In these blowers the flow of air from the fan is directed into a box where it is forced through a fine mesh screen tray. The tray, of an oblong shape, about 36 in. by 12 in., is provided across its width with a set of riffles, and is set in the box at an inclination calculated to allow the particles of rubble not eliminated by blowing, to cascade over the riffles out of the box. The gravel (which has been passed through a 3/4 in. screen before treatment) is fed through a hopper on to the upper part of the screen, the gold sinking behind the riffles.

In practice a clean-up is carried out every 20 or 30 minutes, the concentrate being collected by removing the full screen and substituting an empty one, the operation taking only a few seconds.

About 2 cu. metres of gravel will yield, in this particular type of blower, about 20 lb. of coarse concentrate, which is subsequently panned with a little water and the gold collected.

The experimental work carried out during the last six months of 1936 gave such encouraging results that it was decided to adopt this method for large scale production.

Mechanical equipment is being installed for the excavation of gravel and an improved type of dry-blower is being constructed which it is believed will permit of the profitable treatment of gravel containing as little as 0·3 gm. of gold per cu. metre.

Photographs and specimens illustrating the use of the blower are being placed on exhibition in the Tanganyika Court of the Imperial Institute.

Geology and Mines of the Gwanda Gold Belt, Southern Rhodesia.—An aerial survey of the Gwanda Gold Belt was carried out in 1936 as a basis for a geological survey of the area, but as some years will elapse before the whole of the geological work can be completed, a preliminary report on the reefs at present under development has been issued (*Short Rep. Geol. Surv. S. Rhod.*, No. 30, by R. Tyndale-Biscoe).

Plans and descriptions of numerous properties are given, together with a general map of the Gwanda district.

The Gwanda gold belt lies on the southern flank of the Southern Rhodesia plateau, where the country falls from the Matopo hills escarpment to the valley of the Shashi and Limpopo rivers. The rocks of the belt consist principally of quartz schists, greenstones, conglomerates, phyllites, banded ironstones and serpentine striking east to west, the productive portions lying approximately between the Tuli and Umzingwane rivers. The rocks have been intruded first by granite and gneiss and later by sills and dykes of dolerite.

Gold occurs in fractures, shear zones, and shatterbelts at the base of the schist or in the granite contact, and particularly in the greenstones, but seldom in the serpentine. Auriferous quartz veins in greenstone, schist, or phyllite are always lenticular, with shoots of rich ore, and these which form the most productive type of deposit are most abundant east and south-east of Gwanda. Next in importance are impregnations in banded ironstones which are common north-west of Gwanda where the ore is of low grade and working is at present confined to the oxidised zone. High and low grade impregnations in shear zones of quartz schists occur near the confluence of the Tuli and Malemi rivers, while massive white quartz reefs, associated mainly .with schist inclusions in the granite, are confined to the eastern end of the belt.

The largest producer at present is the Jessie Mine, which treats 800 tons a month and recovers 4 to 5 dwt. per ton. A strong fracture in hornblende-schist containing erratic distributions of pyrite, pyrrhotite, chalcopyrite, and galena in bluish granular quartz, forms the main reef. The mine is being developed on the seventh to twelfth levels.

Another important mine is the Abercorn, 4 miles E.S.E. of Gwanda. Two reefs of banded quartz striking N.N.E. and dipping 60° to the west are developed on the property, where the country rock strikes roughly east-west. The old Abercorn reef occurs in greenstone schist while the New Abercorn reef is mainly in the quartz schist. The veins are contorted, but the gold values are not related to the folding. Production has been continuous since 1913 and 107,000 tons of 11·9 dwt. ore have been treated.

The Farvic mine, on Cleveland farm, is situated 1½ miles south-east of Colleen Bawn Siding. The reef is a fracture zone containing quartz lenses which strike east-west and dip 30° to the north. Development is proceeding at and below the third level where the reef is cut off by a dolerite dyke. Since the commencement of production in 1909 the mine has yielded 72,442 tons of 14 dwt. ore.

West of Farvic is the Bucks Reef, a strong vertical fracture

containing lenses of quartz with pyrite, pyrrhotite, and arsenopyrite. The ore shoot, though only 200 ft. long, has been followed 900 ft. down. Since 1907, 49,805 tons of 17·5 dwt. ore have been milled. At the neighbouring Prince Olaf property there is a white quartz vein up to 2 ft. wide which has yielded an output of 19,959 tons of 13·4 dwt. ore since 1915.

The Big Ben mine, 5 miles east of Gwanda, is being developed on the sixth level and a new main shaft is being sunk. The ore bodies are quartz veins in a wide shear zone where the ore shoots correspond with the larger quartz lenses and payable values are found in grey granular quartz. Since 1911, 46,732 tons of 10 dwt. ore have been treated.

The Horn Reef, situated 13¼ miles east of Gwanda, consists of 1,000 ft. of shear zone in the granite, near the schist contact. The workings have not extended below the water level at 80 ft. A feature at this mine is an abundance of aplite dykes, which are no indication of gold values. The mine has recently been taken on tribute. Since 1918, 43,160 tons of 5·7 dwt. ore have been treated. The Lone Hand, 2 miles north of the Horn property, contains a 3½ ft. shear zone in quartz schist, heavily impregnated with carbonates, pyrite, and pyrrhotite. The reef has been developed to a depth of 500 ft. and stoped along 400 ft. of strike. Between 1912 and 1924, 22,507 tons of 10·5 dwt. ore were produced.

Besides these more important mines there are a large number of less productive properties and some promising new ones. Moreover, if the difficulties of water supply can be overcome, many mines now derelict will recommence operations. The total recorded production of the area exceeds £3,500,000.

Important Discovery of Stanniferous Ironstone in Johore.—An interesting and important deposit of haematite associated with tinstone at Pelepah Kenan, Kota Tinggi district, in the State of Johore, is recorded in the Annual Report for 1936 of the Senior Warden of Mines, Federated Malay States, an advance copy of which has been supplied to the Imperial Institute. An outcropping deposit of haematite was prospected in this area in 1934 by means of pits and adits driven into a spur. The holders of the original Prospecting Licence, namely the Ishihara Sangyo Koshi, Ltd., subsequently applied for a renewal, but eventually only a Boring Permit was issued on account of possible difficulties in connection with a water supply scheme near by. Whilst waiting for the issue of the Boring Permit, the company had their previous samples re-assayed, and found that in every case the iron-ore carried values in tin. When the Boring Permit was issued such of the old adits as were accessible were check-sampled and assayed, the result fully bearing out the previous assays as to the tin values.

The old adits were then repaired and a connection made right through the spur and crosscuts put out. Regularly spaced pitting was done and an adit started at 100 ft. below the former lower adit. Systematic sampling of the pits and all drives and crosscuts showed that in every case the iron-ore contained values in tin. These values naturally vary, but it would appear that the whole of the iron-ore deposit so far exposed is economically workable for tin with the iron-ore as a valuable by-product. The actual tonnage available is not yet computable with accuracy, but there is no doubt that it is very large.

The bottom adit was started in country rock (biotite-schist) with the idea of proving the iron-ore body in depth. This country rock has been proved to contain tin in even better values than those exposed above in the iron-ore body. The tin-ore occurs in a number of more or less horizontal quartz-veins, and, although it is not confined to these veins, they are frequently the richest parts. The downward continuation of the iron-ore body has not yet been reached, and driving of the bottom adit continues. An air-compressor is to be installed, as progress is becoming slow owing to the hardness of the rock and the length of the galleries. Although a great deal of prospecting has yet to be done, it is apparent that the deposit is of major importance. The same company have a Boring Permit over another smaller deposit of iron-ore near by, at Pelepah Kiri. Work had just started on this at the end of the year and assay results were not then available, but, from rough hand-washing of samples, it appears likely that tin is associated with the iron-ore in this case also.

Further details regarding the geology and mineralogy of this interesting occurrence will be found on pp. 18 and 19 of the recently published report for 1936 of the Geological Survey, Federated Malay States.

Manufacture of Ferro-chrome in the United Kingdom.—Hitherto the requirements of British steel manufacturers for ferro-chrome have been met entirely from imported material, derived principally from Scandinavia where cheap hydro-electric power for reduction purposes is readily available. In 1935 10,122 tons of ferro-chrome were imported into the United Kingdom, Sweden contributing 5,368 tons and Norway 3,922 tons of this total. The imports in 1936 amounted to 17,806 tons.

It is therefore of great interest to note that a company to be known as the British Electro Metallurgical Company has recently been formed under the chairmanship of Sir Edmund Davis for the purpose of manufacturing ferro-chrome and other alloys in Sheffield.

Magnesium Alloys.—In a recent paper read before the Royal Aeronautical Society (*Jour. Royal Aero. Soc.*, 1937, **41**, 369), Dr. C. H. Desch discussed the properties of magnesium alloys.

Magnesium is too weak to be used for structural purposes in the unalloyed state, yet the metals which can be added are few. It has been shown that two metals whose atomic diameters differ by more than 14 per cent. will not form a strong alloy, and this leaves lithium, aluminium, cadmium, zirconium, silver, gold, mercury, tin, antimony, thallium, lead, bismuth as the only possible metals that can be alloyed with magnesium. The last five of these make magnesium brittle, while gold, silver, and mercury are too heavy for light structures. Lithium and zirconium offer other difficulties so that aluminium and cadmium are the practical alternatives. On the other hand small quantities of calcium, cerium, zinc, nickel, cobalt, and manganese may be added in order to modify the properties of magnesium or its alloys.

Though metallic magnesium is notoriously inflammable, it is easy to cast, provided that it is surrounded by a flux of chlorides and fluorides and an inert atmosphere of sulphur dioxide. The atmosphere can be supplied by mixing sulphur, boric acid and ammonium bi-fluoride with the moulding sand. Oxidation must be guarded against in annealing the castings, either by covering them with a mixture of sodium and potassium dichromates or by treating them in a muffle, the floor of of which is strewn with iron pyrites.

A good deal of information is now available on the working properties of magnesium and its alloys. Age hardening is fairly effective, but heat treatments for increasing strength are not effective. An important fact is that molten magnesium does not dissolve gases, and, consequently, does not give spongy castings.

One of the chief difficulties in the use of magnesium is its corrodibility. Varnishes are used for protection but do not last very long. Small additions of other metals have not been found effective, except to a small extent in the case of manganese. Chemical surface treatment is considered to be the most promising protection. Experiments are now being carried on to test the possibilities of selenium or magnesium fluoride films, but the only coating at present in production is that of magnesium chromate. Paints and varnishes, which will not adhere to the metal itself, can be applied successfully to this surface. An interesting and important case of corrosion is the effect of "leaded fuels" on aircraft fuel tanks, but the damage may be prevented by the addition of 1 per cent. of quinoline to the fuel or by the removal of all moisture by suspending a cartridge of potassium fluoride in the fuel. The

chlorides present in sea air break up the protective coatings and necessitate the use of inert varnishes on the coatings. The sand particles in desert air rapidly remove all protection so that magnesium alloys are not suitable for propeller construction. The use of chlorides in the fluxes necessitates a very careful cleaning of all castings and welds to prevent subsequent corrosion.

A New Process for the Production of Alumina.—For many years past the Bayer process has been the one most largely employed for the extraction of alumina from bauxite. This process consists essentially in treating the crude bauxite with caustic soda under pressure, when the alumina and silica go into solution, leaving the ferric oxide, etc., known as " Red mud," unattacked. The chief drawbacks to this process are that it involves the handling and evaporation of large volumes of solution and that it requires a high-grade bauxite with a low silica content.

A new process, known as the Séailles process, after its inventor, said to permit the use of cheaper grades of siliceous bauxite and to give valuable by-products, has been described by A. Troller (" Un Progrès Important dans l'Industrie de l'Alumine. Les Procédés Séailles." *La Nature*, Paris, 1936, No. 2968, pp. 4-8).

The process commences with the production of crude calcium aluminate by calcining a mixture of bauxite and limestone. Hitherto calcium aluminates have only been obtainable by calcination of the raw materials at a high temperature, the resulting products being of somewhat variable composition and very difficult to grind. In the Séailles process, however, the calcination takes place at a relatively low temperature (950° C.-1,100° C.), the calcined product is friable and easily ground and its solubility in water is at a maximum. It is claimed that siliceous bauxite may be used without disadvantage.

The crude calcium aluminate is next treated with water on the counter-current principle, under carefully controlled conditions, and the resulting solution of calcium aluminate is filtered and immediately treated with purified carbon dioxide obtained from the first calcination, whereby a mixture of anhydrous alumina and calcium carbonate is produced.

The final separation of the alumina from the calcium carbonate can be brought about by treating a suspension of the mixture with water saturated with carbon dioxide, when the calcium goes into solution as bicarbonate, leaving a residue of alumina containing not more than one per cent. of calcium carbonate.

It is claimed that the process is more economical in working

than the Bayer process, particularly as regards fuel consumption, and also enables cheaper grades of bauxite to be used. As the alumina is obtained in the anhydrous state, it is claimed that the handling and transport charges are lower than those incurred by the hydrated material obtained in the Bayer process.

Recent Developments in the Production of Aluminium.—An article by G. Boex in *The Metal Industry*, 1937, **50**, 83-86, discusses recent developments in aluminium production. These improvements enable the metal to be produced in any desired degree of purity, a position attained through efforts that have been made to control every stage of production.

The first stage in the production of aluminium is the preparation of alumina from crude bauxite, and it is interesting to note that the Bayer process is holding its own although several others, e.g., the thermal process in Canada and the Haglund process in Germany, have been tried on a commercial scale and appear to have been abandoned. It is stated that of the newer methods the Pederson process is the only one that shows any signs of success, but it should be noted that the Séailles process outlined in the preceding Note does not come under the consideration of the author. Calcination of the hydrate is carried out practically universally in large rotary calciners, and the choice as to whether oil or producer-gas should be used is largely a financial question.

Electrolytic reduction of the alumina has been subject to great improvements. Cells are now employed which consume currents as great as 40,000 ampères, and their size has been increased up to five times that of the old cells. The number of electrodes increases proportionally, and, as frequent adjustments and replacements are necessary, the tendency has been towards an increase in their size. As a result the popularity of the Söderburg electrode has increased. This consists essentially of an aluminium sheet-casing into the top of which a carbon mixture is fed as a paste, the heat of the electrolyte into which the electrode dips baking it as it is lowered during use. As the electrodes are consumed it is necessary to know and control the composition of the ash. A dip sample is taken each day before tapping to determine into which blending furnace the charge is to be placed.

Blending and remelting furnaces have also undergone improvements. Electric furnaces have been tried to a considerable extent, but, although they possess theoretical advantages, they have not yet replaced furnaces fired with producer gas, particularly the semi-producer coke-fired type.

Casting problems become more difficult as the size of the mould increases. Cast iron appears to be more favoured than

other materials for the moulds, and split moulds tend to give better results if the bolts are of steel of special tensile strength.

One of the outstanding discoveries of recent years has been the electrolytic method of R. Gadeau, of France, for the commercial production of metal of over 99·99 per cent. purity. Cleanliness appears to be essential for its success. The fabricated product is very fine and possesses a high resistance to corrosion, great ductility and softness, and special electrical properties, useful, for instance, in condensers. It is possible that it will lend itself to use in special alloys.

New Process for Concentrating Lithium Ore.—A simple inexpensive method for beneficiating spodumene ores has recently been described by F. Fraas and O. C. Ralston in *Rep. Invest. No.* 3336, *U.S. Bur. Min.* (Feb. 1937). The process, which was developed in consequence of difficulties encountered in the concentration of such ores by means of jigs and tables, is based essentially on the fact that ordinary or alpha spodumene is transformed into a soft pulverulent beta variety by calcination at about 1070° to 1080° C. The calcined ore is selectively ground, so that the gangue minerals such as quartz and felspar are affected but little, the spodumene being subsequently recovered by vibrating screens, air-flotation, or by any other convenient method of ore concentration.

The authors recommend small kilns fired with wood, oil or gas for calcining the ore, but suggest that shaft kilns, as commonly used for lime burning, would probably prove satisfactory, provided that the ash from the solid fuels were not excessive. The grinding of the calcined product may be done by means of a pebble mill, or by one in which the pebbles are replaced by wooden blocks.

It is estimated that the calcining costs should amount to not more than $2 to $3 per ton of ore, and that concentrates of beta spodumene should be produced in the United States at about $10 to $12 per ton at mine.

Beta spodumene is said to be more suitable for use in the ceramic industry than the ordinary variety, as the latter increases considerably in volume during firing. Moreover, it is claimed that beta spodumene is more easily decomposed chemically, and can consequently be used with advantage for the extraction of lithium, whatever process is employed.

Mud Fluids for Petroleum Drilling.—There are three drilling systems in regular use in the oil industry : percussion or cable-tool drilling, core drilling, and rotary drilling. The rotary drill, of comparatively modern development, is by far the most important, and has enabled the prospector to reach depths of ten and even twelve thousand feet in his search for

new supplies of oil; the essential feature of the "rotary" is a long pipe rotating at high speed and carrying at the end a suitably designed bit. In the early days of rotary drilling it was customary to remove the fragments of rock by means of a stream of water which passed down the inside of the pipe carrying the bit, through apertures in the drilling bit, and up through the annular space between the pipe and the walls of the hole. In wells drilled through clay or shale the water in circulation became muddy and sometimes so viscous as to necessitate addition of fresh water and rejection of a part of the fluid in circulation. By reason of its increased density, however, this clay-laden water had many advantages over clean water as a circulating fluid for the removal of cuttings, and the use of a mixture of clay and water—termed mud-fluid or drilling mud—for rotary drilling is now a universally accepted practice.

The increase in depth to which wells have been drilled has brought with it a very great increase in the difficulties of drilling, and within the last few years the need for finding the most suitable clay-water mixture for the conditions encountered has become more generally appreciated. The importance of drilling mud is illustrated by an instance in which over £25,000 was spent on the provision of drilling mud for a single rotary well, and it is evident that the properties of this "mud fluid" deserve the most careful investigation.

An informative paper by P. Evans and A. Reid (*Trans. Min. Geol. Inst. India*, 1936, **32**, 263 pp. + xxx) discusses the preparation and more particularly the testing of rotary drilling mud. The aim of the writers has been to discuss experimental results obtained in the laboratories of The Burmah Oil Co., and to review the wide literature to which they have had to refer.

Drilling mud is usually made in a central plant for distribution to a number of wells, and methods of manufacture are based on churning, jetting, or preferably a combination of these. A method of jetting, often termed hydraulicking, is useful in mixing up soft clays or shales; a high-pressure jet of water is forced on the clay face, and the resulting thin mud re-cycled until it reaches the desired consistency. In hopper mixers there is a horizontal jet below an inverted cone, and ground clay or shale is fed into the mouth of the hopper, sucked down by the vacuum created by the jet, and so mixed intimately with the water.

The mud plant must also deal with the reclamation of used mud, especially desirable where the cost of fresh mud is high. Removal of sand and cuttings brought up during drilling is achieved by a settling ditch along which the mud flows, by passage over vibrating screens, or by centrifugal means.

The vibrating screen is also useful in removing gas which becomes trapped in the mud when drilling through gas sands and may remain there with remarkable pertinacity. The simpler means of cleaning the mud are provided at all wells, and the more elaborate ones at important wells and in the central mud plant.

To obtain the best results in both preparation and use adequate testing is necessary, and such characteristics as density, viscosity, thixotropy or setting-quality, acidity, alkalinity, and salinity are all of importance in determining the efficiency of any mud. In addition the quantity and nature of the sand gathered by the mud as it circulates is an indication of the degree of abrasion to which the pumps may be subjected.

It may be noted that barytes is extensively used in making up these muds in Trinidad as well as Burma, and in most of the United States and Russian oilfields.

South African Emeralds.—It was reported in the *Quarterly Information Circular* issued in March 1937 by the Department of Mines, Pretoria, that a new discovery of emerald had been made in the Leydsdorp district of the north-eastern Transvaal. The site is only about 600 yds. south of that formerly worked on the farm Willie No. 481, and here also the emeralds are associated with pegmatites intruded into biotite-schists. The pegmatites themselves contain pale green beryl, but in the contact rim the colour is deeper, and, although the majority of the stones are marred by flaws and cloudy parts, many gems of large size and marketable quality have been obtained. Some 450 carats of these stones have recently been exported to India.

Radium in Canada.—The discovery of pitchblende and silver ores by Gilbert LaBine at a point to the north-west of Echo Bay, Great Bear Lake, North-West Territories, in May 1930, was one of the most romantic events in the history of mineral exploration. Considering the remoteness of the region, its severe climate, and the many handicaps which hamper all mining operations there, the establishment of a modern mining plant capable of handling 100 tons of ore a day and permanently employing more than 100 men is a remarkable achievement.

The deposits at LaBine Point are situated about 40 miles south of the Arctic Circle, which explains the severity of the climate, the summer being very short and cool, and lasting only about three months, and the winter long and very cold, the temperature falling to nearly —80° F. on occasions.

With the exception of timber, obtained locally, and oil fuel, which is brought 245 miles by water from Fort Norman

on the Mackenzie River, all supplies come by water during the summer from the railhead at Waterways, Alberta, a distance of 1,375 miles, which includes one portage only of 16 miles from Fitzgerald to Fort Smith. The route is along the Athabasca, Slave, Mackenzie, and Great Bear rivers, and across Great Bear Lake to LaBine Point. Freight, consisting of supplies inward and ore outward, is carried by a 100-ton barge towed by an oil-driven launch, passengers being conveyed by the steamers of the Northern Navigation Company. The passenger journey, however, is long and tedious, taking six weeks, so that it is not surprising that aeroplane services are in operation over the more direct route of 850 miles.

The pitchblende deposits are worked by Eldorado Gold Mines, Ltd., at the Eldorado Mine, where the pitchblende is found in three almost parallel shear zones of complex character in altered pre-Cambrian rocks associated with granite, which possibly is the source of the mineral. The zones, known as No. 1, No. 2, and No. 3, are roughly 100 ft. apart, striking east-north-east and dipping steeply to the north-west.

Preliminary prospecting by 17 trial pits, sunk in 1931, showed pitchblende in all three zones, but No. 2 proved decidedly the most promising, having, besides the pitchblende, valuable amounts of silver, chiefly native in the form of wire, plate, and leaf, towards the north-east end of the lode.

At an early date the Eldorado Company, with the help of the laboratories of the Canadian Department of Mines, began to investigate the problem of extracting radium from its pitchblende ore, which is of a different character to any previously found in the world. A processing plant was built at Port Hope, Ontario, which is 3,000 miles from the mine, and treatment started on a 17-ton shipment of hand-picked pitchblende in 1931.

A set of diesel engines was installed to drive lighting, compressor, and other plant, as well as a 100-ton concentrator at the mine in 1932, and systematic underground mining was started towards the end of the year.

More than 22,000 tons of ore were milled during 1936. New levels were opened up at 340 and 590 ft., and exploration at that depth confirmed the continuity of the pitchblende and its regular distribution in the ore ; in fact the vein shows the greatest average width at the lower level.

Regular annual shipments of pitchblende and of silver concentrates and rich ore to Port Hope have continued since 1932, and the radium plant commenced in May 1933. The production of radium has grown rapidly, the outputs being 3 gm. in 1933, 3½ gm. in 1934, 8½ gm. in 1935, and by November 1936 the total production had reached 1 oz. (28 gm.).

Owing to the scale of its operations the Eldorado Company

has been the means of reducing by one-half the world's price of radium. In view of the estimated pitchblende reserves in the mine and the steadily increasing demand for radium, the company has recently decided to treble the scale of its operations, and during 1937 will enlarge its plant at Port Hope accordingly. It has contracted to deliver 50 gm. of radium during the year.

The radium bromide produced in Canada, which is exceptionally free from mesothorium, is sent to England for measurement of its radio-activity. Uranium salts, in the form of sodium uranate, uranium nitrate and uranium oxide are sold through the Standard Chemical Company, of Pittsburg, U.S.A., in the United States and South America, and Messrs. J. Hudson & Co., of London, England, in the British Empire and Europe.

Barium Aluminium Silicates as Refractory Materials.—Aluminium for the manufacture of alloys or for casting is usually remelted in crucibles or special furnaces. The use of the reverberatory furnace, though often desirable, is generally avoided on account of the reaction between the molten metal and the furnace lining, whereby some of the aluminium is oxidised to alumina with reduction of the silica of the refractory to silicon, which dissolves in the metallic aluminium or alloy and alters its physical properties. Great interest, therefore, is likely to be shown in a paper recently read before the Ceramic Society by Dr. F. Singer (*Trans. Ceram. Soc.*, 1936, **35**, No. 9, pp. 389-400), in which the author claims to have satisfactorily solved this problem by the use of a new refractory, barium anorthite.

Barium anorthite (celsian) $BaO.Al_2O_3.2SiO_2$, with a melting point of 1780° C., occurs as a natural mineral, and can, theoretically, be made by mixing 43·3 per cent. of barium carbonate with 56·7 per cent. of clay substance, and heating to 1400-1500° C. In practice, however, its manufacture is complicated by the impurities present in the raw materials, and trials with each refractory clay used (which should always be as free as possible from quartz) are necessary to determine the proportions giving the product with the highest melting point. The possibility of replacing barium carbonate, which is a poisonous substance, by barium sulphate was tried, but with unfavourable results, the product being of a dissimilar character and with a lower melting point.

Tests showed that refractory bricks of a highly resistant nature could be made from a mixture of two parts of grog (made from barium carbonate-clay mixture previously fired at 1400-1500° C.) and one part barium carbonate-clay mixture. In the manufacture of these products, however, both grog

and bricks must be heated for a sufficiently long period for at least two phases to be produced, one of which must always be a glass (refractive index $1 \cdot 560$ to $1 \cdot 595$) and the other always celsian ($BaO.Al_2O_3.2SiO_2$). The firing temperature and the firing time must be so regulated that the formation of spinels cannot take place.

In addition to being unattacked by molten aluminium and aluminium alloys, barium anorthite bricks are stated to have the following characteristics :—

(1) They are resistant to salt glazes ;

(2) They are impenetrable to X-rays ;

(3) Their co-efficient of expansion is on the average $2 \cdot 4 \times 10^{-6}$ (compared with $4 \cdot 0$-$5 \cdot 0 \times 10^{-6}$ for normal refractory bricks) and can in the case of certain bodies be lowered to $1 \cdot 3 \times 10^{-6}$;

(4) They have a specific gravity of $3 \cdot 3$; and

(5) Their impact strength is more than $3 \cdot 0$ cm.kg/cm^2 (compared with about $1 \cdot 0$-$1 \cdot 5$ cm.kg/cm^2 for standard refractory bricks).

These special properties have been used successfully for the following commercial purposes :—

(*a*) the lining of salt glaze kilns for the stoneware industry ;

(*b*) the production of tiles, made as a non-porous porcelain-like body for X-ray protectors and insulators ;

(*c*) the manufacture of specially effective pebbles for ball mills ;

(*d*) the production of refractory bricks having a good resistance to sudden temperature changes, and also, on account of their high basicity, a good resistance to many aggressive chemicals.

The author's experiments showed that part or the whole of the barium oxide could be replaced by strontium oxide, but that no advantage was to be gained by this replacement.

Use of Rare Earths in the Coloration and the De-colorising of Glass.—The rare earths, which occur in nature in a number of minerals, are obtained commercially from monazite, which is a phosphate of the cerium earths (cerium, lanthanum, neodymium, praseodymium and samarium) with varying amounts of thorium and yttrium. In the treatment of monazite sand, the earths remaining after the removal of thoria are separated from the phosphoric acid, the crude mixture obtained usually containing about 40 to 50 per cent. of cerium oxide, 30 to 35 per cent. of lanthanum oxide, 15 to 20 per cent. of neodymium oxide, 5 per cent. of praseodymium oxide, and 5

per cent. of other earths. These components can be separated only by repeated fractional crystallisation, about 40 such operations being necessary in order to separate the lanthanum, neodymium, and praseodymium earths sufficiently cleanly for the products to be called " technically pure." In order to obtain chemically pure products, a very much larger number of crystallisations is required, and the price of the pure preparations is necessarily very high. For technical purposes, however, mixed earths of known properties are often suitable.

Some of the rare earths are used in glass manufacture, both for colouring and for decolorising purposes. An account of their application is given by Dr. J. Löffler (" Seltene Erde," *Glashütte*, 1936, **66**, 63-5).

The outstanding features of glasses coloured with rare earths are said to be (1) the great clearness and brightness of the colours, (2) the variation in tone of the colour, according to whether the glass is viewed in thin or thick sheets and by reflected or transmitted light, and (3) the retention of colour in reflected artificial light, in which most coloured glasses appear somewhat dull.

Neodymium oxide colours glass blue with a reddish tone. The so-called didymium preparations, i.e. neodymium not completely freed from praseodymium, produce the same effect more or less strongly. In conjunction with selenium under carefully controlled conditions neodymium gives an intense purplish red colour known as " neodymium ruby."

Praseodymium oxide produces in glass a yellow or greenish colour, the yellow predominating in thin, and the green in thicker, sheets. A mixture of about equal quantities of neodymium and praseodymium oxides gives the so-called " didymium gray," the colour appearing gray to green in thin sheets and in thicker pieces red brown.

Cerium oxide alone gives a feebly reddish yellow colour to glass, but in combination with about twice as much titanium oxide an intense golden yellow is produced. A good iron-free sand must be used, since the cerium-titanium colour is said to be adversely affected by the presence of iron.

In general the rare earth colours do not mix well with other colouring agents in glass, but their use does not affect the general working properties of the batch, nor do the colours alter during annealing.

Mixed earth preparations containing lanthanum should not be used in glass-making, as this oxide, although it has no effect on the colour, is said to have a harmful influence on the physical properties of the glass, producing a kind of crystalline appearance.

In the decolorising of glass with selenium, difficulties have often been encountered owing to the variable behaviour of

the selenium under differing conditions, believed to be due to the different states of oxidation of the selenium compounds formed. Cerium oxide is said to be used as a kind of stabilising agent to hold the selenium in the desired state of oxidation and hence at the required colour stage.

The purer cerium preparations are also stated to be of use in conjunction with pyrolusite for decolorising glass containing not more than 0·02 per cent. of iron. Such a glass is not colourless on leaving the annealing oven, but on being exposed to light for a few days it becomes practically colourless with a very slightly bluish tone. This type of glass is considered to be particularly suitable for glass which will be exposed to intensive sunlight, e.g., architectural glass, since, after the first change of colour, there is said to be no further risk of change on exposure to light.

A New Inorganic Cement.—Many improvements have been made in magnesium oxychloride cements during recent years, but they still retain three fundamental weaknesses : solubility, tendency towards volume changes, and incompatibility with lime compounds.

These faults are said to be eliminated in a new copper-bearing magnesium oxychloride cement described by Dean S. Hubbell in *Industr. Engng. Chem.* (*Industr. Ed.*), 1937, **29**, 123-132. The incorporation into the cement mixture of finely divided copper powder, up to 10 per cent. by weight, is stated to yield a product which is practically unaffected by water, and free from excessive expansion even when placed in contact with materials that contain lime. Other improvements claimed in the quality of the resulting cement are greater strength, freedom from efflorescence and warpage, and increased resistance to abrasion. The reaction between the magnesium chloride of the cement and the added copper removes the excess magnesium chloride from the cement and results in the formation of a blue-green coloured compound, cupric oxychloride, which is unaffected by water and protects the magnesium oxychloride. It is not stated in what form the magnesium is combined after the chlorine has reacted with the copper. The copper particles do not at once react completely, but their conversion to oxychloride is continued over long periods. Some copper, therefore, remains in the cement to convert to the new phase any magnesium chloride that becomes available from subsequent hydrolysis of the magnesium oxychloride.

This tendency of oxychloride cements to hydrolyze has in the past placed great limitations on their use. When such cements are exposed to weathering or repeated washing, the magnesium chloride, produced by the hydrolysis of the oxy-

chloride, is progressively removed and the cement ultimately crumbles. If, on the other hand, the magnesium chloride is not washed away, but is allowed to remain in contact with the cement, its presence accelerates the disintegration of the remaining oxychloride.

This means of preventing such hydrolysis may, if successful, open up new fields of employment for these cements. It is interesting to note that the work described is said to be the outcome of a study of materials which might react with the cement to form a synthetic counterpart of some natural mineral, and that the copper compound produced in the cement is stated to be identical with the mineral atacamite, naturally occurring cupric oxychloride.

RECENT RESEARCH ON EMPIRE PRODUCTS

A Record of Work conducted by Government Technical Departments Overseas

AGRICULTURE

Soils and Manures

Nigeria.—The following report on the work of the Chemical Section at Ibadan, Southern Provinces, by Messrs. H. C. Doyne and K. T. Hartley, for the period July-December 1936 has been furnished.

Nitrification in Acid Soils.—Leaves of a leguminous green manure crop (*Mucuna utilis*) were incorporated with limed and unlimed soils having *p*H values varying from 4·1 to 7·5 in proportion to the lime applied. The mixtures were leached with water every week and the nitrates in the leachates determined. The rate of nitrate production and the total amount of nitrates produced were in direct proportion to the increase in the *p*H value.

Acidity of Mangrove Swamp Soils.—Soils taken from a mangrove swamp when slowly air-dried have, in most cases, phenomenally low *p*H values (between 2 and 3). They produce free acidity and soluble ferrous salts in water extracts. It has been found, however, that the *p*H value of these soils in the wet state, determined as soon as possible after sampling, was about 5. On storing the soils in a moist state, after thoroughly stirring them, the *p*H steadily dropped, the lowest figure obtained being 0·97 determined on a quinhydrone electrode.

The pH value of such a soil could be raised to a value between 3 and 4 by repeatedly leaching out the free acid with water. The increase in acidity is probably due to the oxidation of ferrous sulphide to ferrous and later ferric sulphate; the latter is hydrolysed to ferric hydroxide and free sulphuric acid. The amount of water-soluble sulphates increased with the acidity.

Green Manuring Experiments.—Pot experiments in which equal weights of the roots, stems, and leaves of a leguminous green manure crop (*Mucuna utilis*) was tried against a non-leguminous crop (*Ipomoea* sp.) gave the following indications (not statistically significant).

(*a*) The leguminous crop produced considerably more leaves than the non-leguminous.

(*b*) The roots of both crops (equal weights) had a depressing effect on the yields; the non-leguminous more so than the leguminous.

(*c*) Equal weights of the stems of both crops increased the yield (the non-leguminous more than the leguminous). Burning the same weight of stems increased the yield further. Increasing the weight of stems dug in increased the yield.

(*d*) Leaves of both leguminous and non-leguminous crops increased the yield to a greater extent than the same weight of stems. Increasing the weight of leaves dug in gave a higher yield. Burning the leaves gave a greater increase in yield than digging in the same weight green.

On the field experiment at Moor Plantation where the yields from digging in green or burning the cover crop are similar, it was found that the available phosphate was definitely higher on the burnt plots when sampled in May at the beginning of the growing season. December samples showed that this difference was not maintained to the same extent, and that while all the plots showed a drop in available phosphorus content the loss was appreciably greater on the burnt plots than on those where the cover crop had been dug in green.

Mr. W. A. Watson, Agricultural Chemist, Northern Provinces, reports as follows.

The small-scale field experiment reported last year was repeated on a much larger scale and with some modification of treatments. As lack of response to potassium would appear to have been proved, no treatments involving this were included. While it would also appear that nitrogen alone was of no value, it was felt desirable to note the effect of nitrogen along with phosphorus, and for completeness a treatment of nitrogen alone was included.

The following treatments were decided on :—

2F	= 2 tons f.y.m. per acre.		
P	= Superphosphate P equivalent to	1 ton	f.y.m.
2P	= ,,	,, 2 tons	,,
NP	= Nitrate of Soda N	,, 1 ton	,,
	= Superphosphate P	,, 1 ton	,,
N2P	= Nitrate of Soda N	,, 1 ton	,,
	= Superphosphate P	,, 2 tons	,,
N	= Nitrate of Soda N	,, 1 ton	,,
O	= No Manure.		

A modified Latin Square layout was adopted with 12 replicates of the 7 treatments. There were thus 84 plots. The size of each plot was approximately $\frac{1}{20}$ acre.

The test crop was guinea corn planted at 2 ft. 6 in. apart, giving 300 plants per plot.

About one month before harvesting a count of the total number of tillers was carried out on a number of plots. The mean figures were as follows :—

Treatment.	Total number of Fruiting Stems per plot.
O . . .	340
N . . .	292
P . . .	405
NP . . .	414
2P . . .	456
N2P . . .	488
2F . . .	463

The number of dead or missing plants was noticeably higher on the N treatment plots. The effect of phosphorus on tillering is notable.

The yield of grain was as follows :—

(*lb. of grain per plot.*)

Block.	O.	N.	P.	NP.	2P.	N2P.	2F.	Block Total.
1	20	85	48	67	43	58	43	364
2	27	33	51	40	37	55	53	296
3	8	18	30	44	54	52	47	253
4	2	23	30	38	52	54	37	236
5	7	24	54	41	39	40	30	235
6	11	17	30	41	50	50	48	247
7	18	30	33	48	64	60	49	302
8	50	33	75	55	65	75	54	407
9	57	36	50	66	66	67	63	405
10	38	27	49	47	46	66	53	326
11	23	26	50	51	52	54	54	310
12	38	33	63	53	57	41	56	341
Treatment Total	299	385	563	591	625	672	587	3722

The significant difference is 84 lb.

It will be noted

that all treatments are better than O ;

that all other treatments are better than O and N ;

that N2P is better than P or 2F.

There are no other significant differences.

As anticipated, N had little effect, either by itself or in combination with P. In combination with 2P, however, it produced a significant increase over P, which 2P alone did not do. It might be that, were the N supplied in a less readily available form, e.g. as ox blood, its effect might be greater.

2F was not as effective as 2P, and only very slightly more so than P.

In general the results follow those of last year's small scale experiment confirming that additional N seems of very small value except in vegetative growth, and that it is phosphate that counts here in grain production.

WEEDS

Lalang Grass

Malaya.—Mr. J. N. Milsum, Acting Agriculturist, in his report for the half-year July-December 1936, states that investigations conducted at the Central Experiment Station, Serdang, with the control of lalang grass (*Imperata arundinacea*) by means of poisonous salts have met with success. Both sodium arsenite and sodium chlorate were employed, but the former was found more certain in its action and less expensive. Sodium arsenite in a kerosene emulsion applied with a knapsack sprayer at the rate of 10 lb. per acre per application, killed out lalang grass in ten applications at seven day intervals. In these experiments the poison solutions were applied during the wet season and direct to the grass without any preliminary treatment. It is now proposed to cut the grass to ground level and chip the surface rhizomes before application in order to ensure that the poisons are applied directly to the soil. This will obviate the necessity for the use of kerosene emulsion with a consequent economy in expenditure.

Trees within the plots under treatment were not affected by the poisons except where actual contact had been made with foliage close to the ground.

The land sprayed is not toxic to plant growth, as cover crop plants and other grasses have commenced growing since the spraying ceased.

INSECTICIDES

Derris

Malaya.—The half-yearly report for the period July-December 1936 of Mr. C. D. V. Georgi, Agricultural Chemist, contains the following account of work carried out on Derris.

The results of analysis of samples of roots from individual

plants of *Derris elliptica* (Singapore type) based on the classification suggested by Mr. M. R. Henderson, Curator, Botanic Gardens, Singapore (see *Malayan Agric. J.*, March 1934) indicated that Changi No. 3 was the best in respect of (*a*) yield of root, (*b*) rotenone, and (*c*) ether extract. A summary of the results is given below. The plants were all between 23 and 24 months old when lifted and the figures for rotenone and ether extract are calculated on a moisture-free basis.

Type of Root.	Average Yield of Air-dry Root per Plant.	Average Rotenone.	Average Ether Extract.
	oz.	*per cent.*	*per cent.*
Changi No. 1 . .	1·7	5·9	21·9
Changi No. 2 . .	4·1	6·6	22·0
Changi No. 3 . .	4·9	9·2	26·4

Large scale solvent extraction experiments with roots of *D. elliptica* (Singapore type) and *D. elliptica* (Sarawak creeping) have yielded extracts of a similar type in both cases. Apart from the slightly higher rotenone content of the former, both yield similar bodies soluble in cold petroleum ether and both yield predominantly the new compound, which is analogous to but widely different from deguelin, when the ethereal solution of the extract after removal of rotenone is treated with caustic potash solution. By further treatment of the resin with alkali in methyl alcohol-ether solution, Sarawak creeping appears, however, to give a better yield of deguelin than the Singapore type.

Mr. J. N. Milsum, Acting Agriculturist, reports that considerable variation in the rooting capability of the several types of *Derris elliptica* exists. Several types, under ordinary conditions of cultivation show very disappointing results and much supplying is commonly necessary. Owing to this reason cuttings are often planted in shaded beds, watered if possible, and planted in the field when rooting has taken place. Experiments with *D. elliptica* Changi No. 3 show that this race is particularly free-rooting and 100 per cent. " takes " is usually obtained. Under favourable conditions cuttings composed of single nodes root readily and soon form plants of sufficient size for planting in the field. This is an important attribute, particularly so in view of the high toxic content of the root of this Derris.

Tephrosia vogelii

Malaya.—Mr. Georgi's report referred to above records also the analysis of a sample of prunings of *Tephrosia vogelii* from Cameron Highlands. Compared with Derris, the ether

extracts were disappointing as the following figures, calculated on a moisture-free basis, show.

	per cent.
Leaves and buds	6·91
Leaf stalks	3·86
Plant stems	3·81

Beverages

Cacao

Malaya.—Mr. J. N. Milsum, Acting Agriculturist, in his half-yearly report for July-December 1936, states that a number of attempts have been made in the past to grow several types of cacao at the Central Experiment Station, Serdang, with no success. In April 1934 a half-acre block of land was planted with cacao seedlings raised from seed collected locally. In this instance overhead shade was provided by establishing *Gliricidia maculata* before the seedlings were planted. The situation selected was a sheltered one. The largest trees have produced a number of sound fruits and show promise of thriving under the conditions obtaining. This is the first time that the Department of Agriculture has managed to establish cacao with any degree of success.

Nigeria.—The following statement of work on cacao conducted by Mr. E. H. G. Smith is contained in the report of the Botanical Section, Southern Provinces, for the period July-December 1936.

Rainfall during the year 1936 was unusually low at Ibadan. The total precipitation being just over 37 in. as opposed to an annual average of just over 49 in. Thus rainfall was approximately 25 per cent. below normal. At Ibadan the rainy season extends from late March or April until October, with a break in the rains in August, usually of about three weeks duration. In 1936 the break in the rains began early in July and lasted for eight weeks. July produced a mere half-inch as opposed to an average of 6½ in., and the rest of the deficiency was split up over the more important rainy months. Only in one month of appreciable precipitation, June, did the rainfall exceed average, and in that month only by a fraction of an inch.

In a more normal year the main cacao flowering cycle extends over the period from the latter half of April to the end of July. In 1936 there was only a reduced flowering at that time, and a great many of the flowers then produced shed, while in June flowering was abnormally low. Heavy flowering commenced in July and some flower production extended right up to Christmas. The main cacao crop was produced from the July-August flowers, and was some six to eight weeks late,

while an appreciable out-of-season crop appears likely to be produced in 1937 from the flowers that appeared in the last months of the year. The shortage of rain in the months of March to May appears to have caused the reduced flower production and heavy shedding in the early months, while the good rains of June and lack of crop on the trees stimulated the good flowering and pod setting of the later months.

An unfortunate effect of the late season has been to upset the production of self-fertilised cacao seedlings for the 1937 supplying and planting. Many of the early pollinations shed, while the seeds of pods harvested since Christmas have largely failed to germinate (*cf.* this BULLETIN, 1935, **33**, 360). During the *harmattan*, temperature and humidity vary daily between the following typical extremes :—

Time.	Temperature.	Humidity.
2.0 a.m. . .	55° F.	80
2.0 p.m. . .	88° F.	20

Work in Trinidad (*4th Ann. Rep. on Cacao Research*, 1934, Imperial College Tropical Agriculture, Trinidad, 1935) suggests that the seed in cacao pods stored at temperatures below 60° F. loses its vitality, and that poor germination results from only a short storage at a temperature of 53° F. Deterioration was also caused by desiccation.

Harmattan conditions commenced on December 19, 1936. Pods harvested up to the beginning of January gave a satisfactory germination percentage. Thereafter germination ceased with the pods of most trees under study, and was very poor with the remainder. By germination the production of an effective seedling is meant, for, as observed by Pyke, many seeds died after the radicles had made a little growth. It appears that cacao pods will resist a certain number of days of *harmattan* conditions, possibly 10-14, without serious loss of seed vitality. The obvious control, when such weather is experienced before cacao germinations are complete, is to harvest pods as early as possible. Some experiments on cacao germination under the conditions described would appear likely to prove of interest, and such may be possible in another year.

Work has proceeded at the experimental cacao farms of the Department. There is a definite lack of knowledge on the growth of cacao in Nigeria under what may be termed plantation conditions, i.e. where regular spacing is employed, and one of the functions of these farms is to provide such knowledge. The native peasant farmers in the Western Provinces are very successful with their small patches of closely-planted cacao, and exceptional yields are obtained. Shade management is not so important in peasant farms. The young cacao is usually established through food crops. And as a result of the very

close initial planting, the heavy losses during the early years still appear to leave a more than adequate stand of cacao on any but unsuitable soil. There is a good deal of natural overhead shade in most farms, provided by mature wild oil palms that are usually left standing, and by surrounding forest trees.

Present experience on the experimental farms suggests that adequate side shade during the dry season, and during the months of medium rainfall, is the criterion for success in the establishment of young cacao. Bananas and plantains have both been tried as a sole nurse crop for cacao. These appear, however, to be too strong growing and are expensive to control, but still seem to be valuable when used in conjunction with other plants. *Tephrosia candida* has so far given promising results; it is reasonably cheap to control, although slow to become established. Natural shrubby growths are also useful. An objection to cassava is that in forest country it is relished by the wild fauna, and animals which enter the plots to eat cassava also turn their attention to cacao seedlings. The most satisfactory shade for establishing young cacao appears to be provided by a judicious mixture of plantains to furnish overhead protection, with Tephrosia and such suitable shrubs as grow naturally to supply the side shade.

As regards the need for permanent shade trees and the most suitable varieties to employ, no definite indications can be expected for some years. *Erythrina* and *Albizzia* spp. are under trial.

A certain amount of trouble has been experienced from cacao thrips, and there is what appears to be an annual infestation of the young seedlings in November or December. Thrips seems to multiply to dangerous numbers when the rains have ceased, and before breeding is controlled by the lower humidity of the full dry season. Spraying with Burgundy mixture has been carried out as a control; but at present the pros and cons of spraying are far from clear. Certainly the above spray reduces the thrips population, but it also adversely affects young shoots and may hasten the dropping of damaged leaves. In 1936, on account of the prolonged dry spell, thrips was also prevalent in July and August. The cacao at one farm, Owena, suffered severely at that time, and, in consequence, supplying is likely to be heavy at that station in 1938. But how much of this was due to thrips, to the lack of rain, or to the paucity of the side shade was difficult to determine accurately. Provided good rain is falling, young cacao seems able to withstand other unfavourable conditions.

Coffee

Nigeria.—In previous reports from the Department of Agriculture accounts were given of the planting up of trial

plots of various types of coffee at Moor Plantation (this BULLETIN, 1932, **30**, 325; 1935, **33**, 365). Mr. F. W. Toovey, in the report of the Botanical Section for July-December 1936, supplies the following further particulars.

An additional plot of Excelsa was planted in 1935 with seed obtained from Trinidad. With the exception of the plots of *Coffea robusta* var. Uganda, *C. stenophylla*, and *C. arabica*, all the older plots have borne well during the past year, considering the dryness of the season and the youthfulness of the trees. A plot of Java Robusta, which has been established at the Departmental farm at Nkwele, is intended to be a source of pure seed of this variety, as no other coffee is allowed to be planted on the farm and there is no coffee grown in the immediate neighbourhood. This plot is now in bearing.

With a view to selection of seed from high yielding trees, preliminary experiments on the artificial self-fertilisation of coffee have been undertaken during the past year. The method used was similar to that described by C. A. Krug in *J. Hered.*, 1935, **26**, 325. Briefly, it consists in covering, just before anthesis, a flowering branch of the tree to be selfed with a cylindrical muslin bag distended by wire loops. After the flowers have opened and then withered away the bag is removed. In the present experiment some of the " bagged " flowers were lightly brushed when they opened with a small brush sterilised in methylated spirits in order to convey the pollen from the anthers to the stigmas. Control experiments were done by removing the corollas and the attached anthers of flowers just before anthesis with a pair of scissors and then bagging in the usual way. About a dozen trees were " selfed " but in no case was any fruit set. The control experiments performed on the same trees also yielded no fruit. It seems, therefore, that there is a high degree of self-incompatibility in the coffee of the Java Robusta variety grown on Moor Plantation. Many other workers have remarked on the self-incompatibility exhibited by *C. robusta* and the present work bears out their findings. It is a phenomenon which raises interesting problems in coffee breeding.

CEREALS

Guinea Corn

Nigeria.—The half-yearly report of the Botanical Section, Northern Provinces, for the period July-December 1936, contains the following statement by Mr. J. K. Mayo, Agricultural Botanist, on trials with Guinea corn.

The trial of 1935 was repeated in 1936 using fresh (selfed) seed of the varieties and sorted seed of the previous year's standard which was a mixture of local types representing the

bulk of the Guinea corn grown in the district. This mixture is, of course, liable to vary in composition from year to year, and the sorting (of heads) was done in order to keep the mixture fairly constant.

The result was as follows, yields being expressed as pounds of threshed grain per acre.

		Percentage of Local Mixture.
Local Mixture	968	100
Strain T	1020	105
Strain Y	848	88
Strain SH	1089	112
Strain SU1	973	100
Strain SU2	876	90

There was no significance.

The results of the last three years are interesting :—

	Local Mixture. *lb. grain per acre.*	AF2. *per cent.*	T. *per cent.*	SH. *per cent.*
1934 at Samaru	768	+38	—	—
1935 at Samaru	968	—	+23	+27
,, at Maigana	688	+45	—	—
1936 at Samaru	968	—	+5	+12

T and SH were derived from AF2, which was far from pure. The three trials were conducted on adjacent blocks. It is a coincidence that the figures for L.M. are the same for two successive seasons. It is possible that there is definite loss of hybrid vigour as these strains become more pure. It is possible, also, that the local mixture has been "improving" or adapting itself to the conditions on the experimental farm, so this latter will be treated as variety next year and fresh local mixture will be obtained from the district as standard.

Maize

Nigeria.—The following statement relating to a maize storage experiment is contained in the half-yearly report for July-December 1936, furnished by Mr. F. D. Golding, Senior Entomologist.

On August 21, 400 cobs with long sheaths were selected in the field during the harvest of early maize. The ends of the sheaths were tied with string and the cobs were attached to wooden frameworks in an open store. On examination on December 4 it was found that 375 cobs had been attacked by caterpillars and were badly weeviled; none of the 25 cobs which escaped caterpillar attack contained any weevils and all were in perfect condition. During the course of the experi-

ment weevils were seen entering cobs through holes made by caterpillars.

Rice

Malaya.—The following summaries of work on rice are contained in the half-yearly reports for the period July-December 1936 furnished by the Adviser on Agriculture.

Mr. B. A. Lowe, Rice Research Botanist, states that selection of local varieties was continued at the Experiment Stations, and varietal trials were continued at the test plots and stations distributed throughout the country.

Using the variety Siam 29 as the male parent, crosses were made with seven other local strains with the object of combining the good grain and yield of Siam 29 with other desirable characters—particularly of straw—of the other varieties. From 437 pollinations 58 grains were obtained.

Other subjects dealt with during the period included observations on the growth of varieties introduced from China and Madras, and on certain varieties grown with an extra four hours of illumination by electric lighting; the question of a classification of local varieties; the sun-cracking of rice and breakage of rice in milling.

Mr. G. H. Corbett, Government Entomologist, states that the principal investigation in connexion with rice insects is concerned with the stem borer problem. Several species are concerned, the most important being species of *Diatræa* and *Chilo*, but *Schœnobius* spp. and *Sesamia inferens* Walk. sometimes cause considerable damage.

The present investigation, which has been in progress since October 1932 is concerned with the fluctuations in population of these insects and with the critical period of growth in relation to attack.

The evidence so far available suggests that population fluctuations occur at definite times of the year irrespective of the abundance of food; that with the variety of padi under investigation the critical period of growth is about the third month, where a nursery of 10 days only is used; and that the two best sowing months are May and June, yields from such sowings being considerably in excess of all others. Whether it will be possible to adhere strictly to such sowing dates, should future investigations prove definitely that they are the best, depends on many factors, not the least of which is rainfall both at sowing and harvest times.

According to Mr. A. Thompson, Mycologist, Rhizoctonia sheath blight and *Sclerotium oryzæ* caused some damage to padi in Kedah. These forms of disease have not been prominent

in past seasons, and appeared to be confined to certain varieties, particularly to some of those which had received a heavy manurial dressing.

SUGAR

Cane

Leeward Islands. *St. Kitts-Nevis.*—A preliminary summary of yield data for the 1936 crop under the St. Kitts' sugar experiment scheme, by P. E. Turner and R. E. Kelsick, has been received. The report gives the yields of cane and sugar in variety trials, and the yield of cane in the following trials: time of planting; distance of planting; various cultural methods (depth of ploughing, opening of the subsoil, etc.); liming with local slaked lime and imported ground limestone; manuring with dressings of sulphate of ammonia, superphosphate, potash, and molasses; and mulching with megasse. In most cases comparative trials were carried out on estates situated in dry and wet areas. Reference can be made here to only a few of the interesting results obtained.

It was found that in a dry area the yield of cane steadily increased as planting was delayed from mid-September to mid-January; it is thought that in an average year the November planting would give the largest yield, provided that a variety suited to the dry areas, such as B2935, is used. In the case of a wet area the average yield of plantings in mid-August, September, and October was significantly greater than that for plantings in mid-November, December, and January, and it would seem that in wet areas planting operations should be completed in October if maximum yield is to be obtained.

As regards distance of planting the yield of both plant and ratoon canes was significantly and obviously reduced in a very dry area as the planting distance in the row was reduced from 4 ft. to 2 ft. In a moderately wet area differences in total yield associated with distance of planting could not be established as statistically significant, although it would appear inadvisable to plant closer than 3 ft. in the row.

In the case of an open, porous deep soil in a dry area increasing the depth of ploughing from 6 in. to 12 in. had no effect on the yield of cane. In another trial in a wet area opening up the subsoil in the furrows by means of a chisel also had neither a beneficial nor adverse effect on yield, but it is thought that beneficial results may be obtained from this experimental operation when the subsoil has had time to weather or when the soil has been limed.

The results of the liming experiments indicated that light dressings of ground limestone (2 to 4 tons per acre) should be applied to slightly acid soils to arrest the development of

acidity before it attains serious proportions, but that heavier dressings on such land or even the lighter dressings applied to areas not in need of lime result in significant loss in yield. In one particular case the application of local slaked lime in amounts of 1·55, 3·10, and 4·65 tons per acre resulted in gains in yield of 3·51, 7·32, and 11·12 tons of cane per acre respectively, and it is thought probable that the beneficial effects will extend to future crops.

On a low-yielding area much larger gains were obtained by mulching in the second half of December when the soil was moist than by waiting until January and February when the soil had dried. On the average there was little to choose between the gains derived from a 2 in. and a 3 in. mulch, but significantly larger yields resulted from applying the mulch between every row than between alternate rows.

Root Crops

Cassava

Nigeria.—Mr. F. D. Golding, Senior Entomologist, in his report for the half-year July-December 1936, deals with the continuation of investigations on the incidence of adult white flies on 19 varieties of cassava. The number of adult white flies which occurred on 10 leaves of each variety were counted during the 17 weeks between August 13 and December 3. In this period of 1935, 374 bugs were counted, and in 1936, 596. Except in two cases, there was a close correlation between the incidence of cassava mosaic and the abundance of its aleurodid vector. For example, in six varieties showing 100 per cent. of plants mosaicked over the two years, the total number of white flies ranged from 77 to 109, whilst in three others showing 50 per cent. of plants mosaicked the number ranged from 24 to 37.

Mr. Golding states that several of the varieties introduced into Nigeria by Mr. J. West in 1933 and 1934 showed no signs of mosaic in 1935 and were apparently unattractive to white flies; in 1936 Aleurodids were two or three times as numerous on these varieties and every plant developed the disease. An experiment, carried out in the early part of 1936, indicated that the apparent immunity of five varieties of cassava was due to an inherent resistance to mosaic rather than to a repellent effect upon the vector; it is now evident that further research is required into the nature of the apparent immunity to mosaic exhibited by certain varieties of cassava.

Sweet Potatoes

Leeward Islands. *Antigua.*—Mr. F. H. S. Warneford, in his report on investigations conducted in Antigua during the

period July-December 1936, gives the following results of a variety trial with sweet potatoes planted in October 1935 and reaped in August 1936. The layout was a six by six Latin Square.

Variety.	Mean Yield. Tons per acre.
V.52	9·25
Bert	8·80
Brook's Seedling	8·65
White Gilkes	7·90
Red Nut	7·30
Moore	7·10

Differences will not exceed 1·3 tons per acre by chance more often than once in 20 times.

Yams

Nigeria.—Reference has already been made in the reports of the Department of Agriculture to the control measures which are being tried out on Moor Plantation against dry rot of yams, caused by the eelworm, *Anguillulina bradys* Goodey (this BULLETIN, 1934, **32**, 449; 1936, **34**, 510). These measures are of a purely agricultural nature, and they involve the following points:—

(i) Use of clean planting material.

(ii) Planting in February, at the beginning of the rains, instead of November, at the end of the rains.

(iii) Burning the cover crop instead of burying it before planting.

The following details, showing the results of some of these experiments, are given by Mr. J. West in the report of the Botanical Section, Southern Provinces, for July-December 1936.

EXPERIMENT I

Treatment of Cover Crop and Time of Planting.	Percentage of Crop Diseased. 1934-35 D5N.	1935-36 A6S.
(i) Cover crop burnt. Yams planted February	8	18
(ii) Cover crop dug in. Yams planted February	7	26
(iii) Cover crop burnt. Yams planted November	87	28

EXPERIMENT II

Treatment of Cover Crop and Time of Planting.	Percentage of Crop Diseased. 1934-35 D6S.	1935-36 B4W.
(i) Cover crop burnt. Yams planted February	47	12
(ii) Yams planted through cover crop November	72	14
(iii) Cover crop dug in. Yams planted November	83	22

It should be remembered that, before any control measures were attempted, the yam crops were showing up to 100 per cent. infection. The most important factor appears to be the use of healthy material for planting. If the seed yams, after being harvested in October, are held in an open store until the planting time in February, it is possible to discard all infected material. With seed yams planted in November it is impossible to know whether the disease is present or not, as the external symptoms frequently do not develop until some time after harvest. An additional advantage for February planting is that it allows the harvesting of the seed from a cover crop producing an edible bean. As regards the treatment of the cover crop there now seem to be indications that the following yam crop is less diseased if the cover has been burnt.

FRUITS

Citrus

Malaya.—According to the report of Mr. A. Thompson, Mycologist, for the half-year July-December 1936, powdery mildew attacked orange trees at Cameron Highlands. The fungus, *Oidium tingitaninum*, was parasitised (but not checked) by *Cincinobolus* sp. Arrangements were made to spray the trees with "amberene" sulphur wash.

Young trees of Japanese citron and Rough lemon were severely attacked by canker (*Pseudomonas citri*). Fortnightly spraying with Burgundy mixture was tried as a control, but although better growth resulted the disease was not fully controlled by the treatment.

Nigeria.—Mr. E. H. G. Smith, in the report of the Botanical Section, Southern Provinces, for July-December 1936, mentions that the plant breeding staff has carried out appreciable citrus propagation during the last two or three years. The total number of citrus plants (grapefruit, sweet oranges, lemons, etc.) distributed for planting on the Departmental Experimental Farms, Farmers' Grapefruit Plots, and elsewhere in 1936 was 2,334.

There is considerable variation in the growth and the development of the citrus plantings that have been made in recent years at the experimental farms. At Ibadan, Agege, and Owena, which fall into the western half of Southern Nigeria, citrus appears to grow satisfactorily, and the development of the young trees is encouraging. But on the acid soils of the Eastern Provinces growth has been very slow, and it seems less certain how successful citrus cultivation may prove in such localities. The poor growth obtained rather supports the view expressed in Technical Communication No. 34 of the

Imperial Bureau of Soil Science that the calcium requirements of citrus are undoubtedly high. In particular very poor results have been obtained so far at Benin and Umuahia, but at these two experimental farms the fertility of the citrus blocks is below even that of the general level of those areas. While it cannot be said that it is impossible to grow citrus in the Eastern Provinces, as, for instance, there is already appreciable local sweet orange cultivation in the neighbourhood of Umuahia, it seems very probable that citrus will not grow as freely on the Eastern Province soils as it does under the more favourable soil conditions which prevail in the Western Provinces.

Mr. J. West, in his section of the Botanist's Report, deals with the attempts being made to control citrus scab (*Sporotrichium citri*). He points out that, as mentioned in a previous report (this BULLETIN, 1936, **34,** 264), the use of shade has not proved satisfactory at Ibadan for the control of scab in sour orange nurseries. An attempt is now being made to obtain healthy stocks by growing them in isolated nurseries, and the results so far obtained are very promising.

The method now being followed is to lay down, each year, a nursery which will contain sufficient sour orange seedlings to satisfy the budding requirements of a single season. Each of these nurseries is isolated from possible sources of scab infection. At the end of the budding season all stocks which have not been budded or which have failed to take are uprooted and destroyed. This measure would remove most of the sources of infection in the event of scab having come into the nursery. In the following wet season all the budded plants should be large enough to be removed for planting in the field, and the nursery site, now containing no citrus at all, can be rested for one or two years before being used again.

It has been noticed that scab is almost entirely absent from the citrus plots at Benin, Onitsha, and Umuahia. The plants used in these plots came from the infected nursery at Ibadan, and they were carefully pruned of all infected shoots in the season following planting out. It is not clear, however, whether the absence of scab is due to this or to the fact that the citrus at all three stations has made such poor growth that there is but little young growth for the disease to attack.

Pineapple

Malaya.—Early in 1936, Mr. W. J. B. Johnson, the newly-appointed Canning Research Officer, arrived in Malaya. This officer was appointed under a three-year scheme supported by the Colonial Development Fund to carry out research work on pineapple canning and to assist the industry generally.

The following report by Mr. Johnson covering the period July-December 1936 has been received.

A small Canning Research Station was started in Kuala Lumpur and equipped with an experimental canning plant and laboratory.

Experiments have been carried out to find the most suitable combination of modern processes for canning Malayan pineapples, work on the various exhaust processes, sterilisation and preparation of the fruit being undertaken with satisfactory results. A successful process has been evolved for canning pineapple juice, and canners have been instructed in its use.

A complete set of tinplate testing machines and apparatus was installed and investigations of the quality of the tinplate used in Malaya were carried out, which indicated that the standard of quality of the tinplate supplied to canners is well below the standard required by British can manufacturers for fruit cans. A tinplate specification has been prepared to safeguard canners against being supplied with inferior quality plate.

The draft Regulations for a Malayan Mark Grading Scheme have been prepared and have received the approval of the industry. It is hoped that the scheme will come into operation during 1937 and that it will stimulate a general improvement in the quality of the high grade packs.

A list of minimum sanitary requirements for pineapple factories has been drawn up and published, and efforts are being made to standardise the sizes of cans used.

Advice has been given to canners who have had to rebuild their factories to conform to the health requirements, in order that the new buildings might be suitable for the installation of modern machinery and in keeping with up-to-date canning practice.

Oil Seeds

Coconuts

Malaya.—The half-yearly reports for July-December 1936, forwarded by the Adviser on Agriculture, contain the following references to the coconut palm and copra.

Mr. R. B. Jagoe, Assistant Botanist, reports that the families of out-pollinated palms at the Klang Coconut Station have been surveyed for selection of four or six families for genetical examination and six individual palms for " selfing " in commencement of breeding work. Selection of these palms is based on high average yields of families, healthy appearance of palms, yields of 30 best individuals in approved families, weight of copra per nut, and quality of copra.

Collection of records of yields, rainfall, and soil conditions from coconut estates is being made in order to find whether

there is any clearly recognisable correlation between rainfall and yields.

Mr. F. C. Cooke, Chemist, Coconut Products, states that a new type of smoke kiln has been evolved which can produce high-grade copra in 24 hours. Small kilns of various sizes suitable for the use of smallholders are now in regular use, while larger kilns operating on the same principle are in course of evolution.

A systematic investigation of the effect of delayed manufacture and of sundrying, nut inversion and nut washing on the quality of copra has been carried out.

Experiments have also been undertaken in the blending of high-grade coconut oil with ground-nut oil, gingelly oil, and the liquid fraction of palm oil (palm oleine) for the production of suitable substitutes to replace the more expensive cooking oils now imported into Malaya for use by the Asiatic community.

According to Mr. G. H. Corbett, Government Entomologist, the investigation to ascertain the relationship of insects with copra has been terminated. This enquiry has shown that insects prefer mouldy or degenerated to good quality copra and it is considered that if the moisture content of copra were reduced to about six per cent., thereby inhibiting the development of moulds, if copra were transported in sacks free from insects, and if copra stores were regularly cleaned, copra free from insects would be generally assured.

Ground-nuts

Nigeria.—Mr. J. K. Mayo, Agriculturist Botanist, in the report of the Botanical Section, Northern Provinces, for the half-year July-December 1936, states that the trial with ground-nuts carried out at Zaria in 1935 was repeated in 1936 using fresh seed from the breeding plot and another variety was included. All were erect types.

The results were as follows :—

Variety.	Kernels.		Tops.*	
	Yield.	Yield as per cent. of control.	Yield.	Yield as per cent. of control.
Control	*lb. per acre.*		*lb. per acre.*	
(Local Mixture)	338	100	878	100
C.C.	395	116	1,056	120
S.	375	111	1,096	125
T.	415	122	1,082	123
M.	366	108	876	100

The Tops are the dried plants after removal of the nuts and include, of course, a certain amount of root.

Castle Cary is the variety at present being distributed to farmers, who appreciate it. It is a similar selection made originally in 1928 and has in previous trials shown increased yields over Local Mixture of 17, 15, and 10 per cent. The percentage of oil and protein was (in one season's analysis) about equal in Castle Cary and Local Mixture. The yields were low this year; 600-700 lb. of kernels per acre is more usual.

This year's results at Kano are not yet available.

Oil Palm

Malaya.—The following statements are contained in the several half-yearly reports for July-December 1936 submitted by the Adviser on Agriculture.

Mr. C. D. V. Georgi, Agriculturist Chemist, reports that an investigation was carried out to determine the extent of the variation in the nitrogen-potash ratios of leaflets from palms under different manurial treatments with a view to anticipating, if possible, manurial requirements, more particularly in respect of potash. The manurial treatments comprised (*a*) phosphoric acid, (*b*) phosphoric acid and potash, (*c*) nitrogen, phosphoric acid and potash, (*d*) control. The results were, however, inconclusive. No significant differences were found between either the potash contents or the nitrogen-potash ratios for the various manurial treatments.

A series of experiments was carried out to determine whether the rate of increase in acidity of palm oil was affected by temperature. This question was raised in connexion with bulk shipment of the oil, some shipping companies preferring to maintain the oil in a liquid condition during the whole of the period in transit. The work showed that even though the oil were kept at a temperature of 140° F. the rate of increase in the acidity remained normal, say between 0·1 and 0·2 per cent. per month for an oil of 4 per cent. acidity, calculated as palmitic acid.

The work on vitamin content of palm oil carried out in conjunction with Dr. I. A. Simpson, Chemist, Institute for Medical Research, has shown that low acidity oil from ripe fruit is richest in carotene. There are indications that Malayan palm oil is much lower in carotene content than some palm oils from West Africa. Tintometric comparisons are being made with oils from fruit of various West African varieties established at Serdang.

According to Mr. A. Thompson, Mycologist, the fungus *Ustulina zonata* can cause a decay of the leaf-bases left on oil palms after pruning. The fungus does not penetrate into

the stem tissue beneath these leaf-bases, and does not cause a stem disease in the above-ground portion of a palm. The fungus has, however, been isolated from a rarely occurring root disease of oil palms which extends to the basal stem tissue below ground causing "charcoal baserot," which eventually may kill the affected palms.

The work carried out by Mr. R. B. Jagoe, Assistant Botanist, included a study of variation in fruit and palm characters of 400 oil palms on a local estate for determination of :—

(*a*) Standards for selection of high yielding palms.

(*b*) Variation in type of palm and correlation with yields.

(*c*) Seasonal and age variations.

Breeding from selected oil palms is also proceeding.

Twelve palms have been selected for selfing. Most of these palms have been selected on high yielding characters, but a few others are included to increase the range of genetical analysis of progeny. It is hoped, eventually, to establish homozygous high yielding strains from some of the best selections.

Seedlings from seven "selfs" have been planted or are ready to be planted at the Central Experiment Station, Serdang; one other has just been pollinated and four remain to be done.

As in the case of coconuts, records of yields, rainfall and soil conditions are also being collected on oil palm estates in order to ascertain whether there is any clearly recognisable correlation between rainfall and yields.

Olives

Palestine.—The following report on investigations relating to the acidity of Palestine olive oil by the Government Analyst, Department of Health, has been furnished to the Imperial Institute.

The Acidity of Palestine Olive Oil

The bulk of the olive oil produced in Palestine unless rectified by artificial means, contains too much acidity for the requirements of foreign markets. There are two qualities: "Mouni" containing from 2 to 6 per cent. acidity, and "Tijari" which may contain anything up to 15 or 20 per cent. acidity. The latter is really only fit for soap making or other industrial purposes, but much of it is sold on the local market as edible oil.

In connection with an investigation still in progress it has been found that oil expressed in the laboratory from selected

olives has 0·2-0·5 per cent. acidity, while unselected olives gave 0·4 to 1·2 per cent. It is common practice, however, to store the olives in heaps for about 10 days prior to pressing in order that they may soften and more readily yield their oil, especially when the primitive hand press is used.

The fermentation which softens the fruit also, however, increases the acidity. In one such heap for example the acidity on the surface was 2 per cent. and in the interior 3 per cent. (on the expressed oil). In a sample kept in the laboratory for 10 days the acidity rose from 0·3 to 6·8 per cent.

The rise in acidity due to this initial fermentation is further increased by the unfavourable conditions still obtaining in many of the village presses. In one such establishment employing a primitive mule driven crusher and hand screw-press the acidity of the oil in the olives before crushing was 4 per cent., while the oil as it came from the press contained 10 per cent. acidity.

Changes in acidity during the storage of the oil have also been taken into consideration. Samples of "Mouni" and "Tijari" oil from selected reservoirs have been examined monthly as long as any oil remained in storage. In eight months an initial acidity of 4 per cent. in the "Mouni" oil increased to 5·5 per cent., while in the "Tijari" oil 12·7 per cent. increased to 15 per cent.

Samples of fly infested and sound olives from the same trees have recently been examined, but there was no evidence that the infestation influenced the acidity of the oil.

Tobacco

Nigeria.—The report of the Botanical Section, Southern Provinces, for July-December 1936, contains the following information relating to leaf curl of tobacco (see also this Bulletin, 1936, **34**, 268, and for fuller details *Trop. Agric., Trinidad*, 1936, **13**, 242).

It has been found that leaf curl has existed in Nigeria for a number of years, and that, generally, the disease can be controlled by late planting.

The past season was remarkable for the lightness of rainfall, in certain areas, during the period when tobacco is normally grown. For example, at Ibadan the rainfall for the six months June-November showed a decrease of 11·1 in. on the average for the years 1910-35 (33·0 in.), whilst at Ogbomosho it was 12·7 in. below the average for 1905-31 (34·3 in.). This abnormal rainfall had a twofold effect in the Ogbomosho area. In the first place the growth of seedlings in the nurseries was checked by the dry period in July and August. Transplanting to the field, which normally takes place in August and September, was delayed, and much of the crop ripened prematurely. In

the second place, white fly, the vector for leaf curl, remained very numerous until late in the season, instead of rapidly becoming scarce towards the end of July, as was expected. In consequence, leaf curl infection was general in the nurseries, and its spread continued in the field. In a few farms the disease was so severe as to ruin the tobacco crop entirely. In the Ipetu area, on the other hand, the rainfall was more normal. There, white fly became extremely rare at the beginning of August, and the tobacco crop was practically free from leaf curl. It seems justifiable, therefore, to expect that, where the rainfall approaches the normal, leaf curl can be controlled by late planting.

DRUGS

Cinchona

Malaya.—Mr. C. D. V. Georgi, Agricultural Chemist, in his report for the half-year July-December 1936, records the following results of analyses of samples of cinchona bark (*Cinchona succirubra*) from 9-year-old trees at Cameron Highlands. The figures are calculated on a moisture-free basis.

	Stem Bark. *per cent.*	Root Bark. *per cent.*
Total alkaloids . .	9·09	13·08
Quinine	2·27	1·66
Cinchonidine . . .	1·97	2·22

RESINS

Lac

Malaya.—Mr. G. H. Corbett, Government Entomologist, in his half-yearly report for July-December 1936, states that three attempts to propagate *Laccifer lacca* Kerr. from consignments received from the Indian Lac Research Institute, Namkum, in Malaya have failed, and it is considered that climatic and other conditions in Malaya are unfavourable to the colonisation of *Laccifer lacca.* A paper dealing with this investigation will be published shortly.

MINERAL RESOURCES

BRITISH GUIANA

The following reports by the Director of the Geological Survey have been received by the Institute from the Commissioner of Lands and Mines regarding the work carried out by the Survey during the half-year ended December 31, 1936.

During the quarter ended September 30, 1936, Dr. D. R.

Grantham relinquished the post of Director of the Geological Survey and was succeeded by Mr. S. Bracewell. Dr. Grantham left the Colony on September 15 on four and a half months' leave prior to his return to Tanganyika.

Gold

Owing to the change-over of staff, field work in the Cuyuni District could not be commenced until late September. Three parties were engaged in surveys of the lower Cuyuni River area; Mr. Bracewell and Dr. D. A. B. Davies working on the left bank of the river between the Groete River and Popekai Fall, and Mr. D. W. Bishopp continuing the work commenced by Dr. Grantham during the first half of the year in the Quartzstone and Waiamu River areas. The parties returned to Georgetown in mid-December to prepare maps and reports dealing with the work.

At the request of His Excellency the Governor, Mr. Bracewell spent one month in an examination of the Konawaruk-Mowasi area and reported on the advisability of an extension of the Potaro-Konawaruk road into this area. During this examination a new trail was opened up from the present road-head into the Mowasi field and this is already having a very beneficial effect upon the development of the field.

The Director made a reconnaissance examination of about 420 sq. miles of country on the left bank of the Cuyuni between the Mariwa and Kutuau Rivers, and thus connected the work of the Economic Geologist in the Quartzstone area with that of the Field Geologist in the Mariwa-Groete Creek area. He also made a brief examination of the Quartzstone and Mariwa areas. Despite its close proximity to the other two gold-bearing areas this belt of country is comparatively barren of gold, the only workable deposits observed being the concentrations of terrace deposits in small creeks close to the Cuyuni. The area is one of gneiss and sheared volcanic rocks with intrusions of dolerite, the foliation, and the intrusions striking 60° east of north. There are a number of belts of sheared quartz in the gneissose area close to its western contact with the volcanic rocks which are in line with and continuous with similar rocks in the Quartzstone area; but whilst in the latter area they are auriferous, in the former they are quite barren.

The explanation of this has been revealed by the more detailed work of the Economic Geologist over an area of 64 sq. miles in the Quartzstone area. (This includes the 16 sq. miles reserved by the Government in consequence of earlier work by the Geological Survey.) Mr. Bishopp has now shown that the auriferous belt follows closely the margin of one of the newer granite intrusions. For some miles the Quartzstone

River also follows this contact, and its flats and bed contain deposits of auriferous gravel suitable for dredging.

This newer granite does not outcrop in the Cuyuni River nor in the barren area to the north of it examined by the Director; Mr. Bishopp's detailed mapping shows that the granite margin turns off eastward before reaching the Cuyuni.

Mr. Bishopp also made a close examination of the Government reserve and has taken a series of samples of quartz and country rock, 44 of which have been sent to England for assay. He is of the opinion that there is a prospect of the establishment of mining and quartz milling operations in the area, and has recommended that the area of the Government reserve be increased so as to take in all the granite marginal area. This recommendation has been acted upon, and the area of the Government reserve has been increased to one of 360 sq. miles until the examination is completed. It is hoped to continue the work on the southern extension of the granite in the next field season.

In the Mariwa area Dr. Davies finds that much of the gold is derived from sheared volcanic rocks of a type somewhat similar to those of the Prestea-Marlu belt on the Gold Coast. The residual clay derived from these rocks shows in the battel values of 4s. per cu. yd. which is quite sufficient to allow of sluicing. On the Gold Coast it has been found that along certain shear zones the country rocks carry fine gold which does not show in the pan and with this in mind samples of these residual clays were taken for assay.

Bauxitic pebbles were observed at a number of places in this area. These may be derived from lateritised clays of the White Sand Series. Analyses are being made of some of these. Further work which might throw light on the nature and origin of the British Guiana bauxites and which might lead to the discovery of workable deposits in close proximity to the deep sea channel in the Essequibo River appears to be indicated.

Full reports and maps dealing in more detail with the work referred to above are being prepared.

A short visit was paid to the "Eldorado Mine" in the Kaburi District, at the invitation of the owners, Messrs. Tiboku Development Company, Ltd. Rich auriferous quartz stringers in decomposed sheared volcanic rocks outcrop in this area and underground exploratory work is being carried out by the Company.

The Oko River property of the British Guiana Goldfields, Ltd., was also visited at the invitation of the company in order to witness the commencement of operations with the slack-line scraper which has been installed to work the gold-bearing flats of the river.

Two reports dealing with gold-bearing areas have been published, viz., " Geology and Gold Deposits of the Potaro," (price $0.72, or 3s.), and " Geology and Gold Deposits of the Konawaruk " (price $0.12, or 6d.).

Manganese Ore

Mr. D. W. Bishopp made a brief examination of the occurrence of manganese at Saxacalli on the left bank of the Essequibo River. This consists of a number of highly inclined veins from 1 ft. to 12 ft. in width following the east-west strike of the surrounding quartzites and phyllites. A number of trenches were excavated at suitable localities across the strike of these reefs over a distance of 2 miles. Samples of the manganiferous rock were taken and these are being analysed. Subject to the results of these analyses Mr. Bishopp's conclusions are as follows :—

Origin of the Deposit.—The manganese ore is extremely siliceous, and is associated with vein-quartz which has been very heavily sheared, and with quartzose material or quartzite which was probably part of the pre-existing country rock. Assays and petrographic studies are being undertaken, but there seems to be little doubt that the " phyllite," in a highly decomposed condition, is derived from a sheared or mylonitised gneiss. The ore bodies are probably of deep-seated origin, and may continue for some way to the westward under the superficial cover of gravel and sand. They do not appear to continue east of the Essequibo River.

Quality of the Ore.—The obviously high silica content, and relatively low content of manganese, would be a complete bar to the use of the material for metallurgical or chemical industry, e.g., for the manufacture of steel or electric batteries. A local market might, however, be found in purifying water or in using the ore for certain agricultural purposes. The question arises as to whether there might not be some enrichment at depth ; but this matter could only be settled by the sinking of shafts below the water-level.

Quantity of the Ore and Accessibility.—On a proved strike of 1¼ miles, and a total average width of probably more than 10 ft., there is obviously a considerable quantity of the material readily available. Beyond this, a good deal of it could be taken from the surface without much excavation in the form of rubble, boulders, and talus. It is very favourably placed as regards boat transport, being right on the river bank for the first 1,000 ft. of strike.

So far, the occurrence would not seem to be capable of commercial exploitation for manganese. There is a possibility that some ore may have been concentrated at greater depth below surface, and that higher grade might be found there.

It should not be unreasonable to sink a shaft down below the water level if possible, and to cross-cut into the clay or rotten phyllite with a view to finding secondary nodular or concretionary ore, of the type exploited in West Africa.

The possibilities of there being a local market for the purposes cited should be followed up. It is hoped to publish the full report later in the year.

CYPRUS

The Imperial Institute has received from the Inspector of Mines and Labour the following report on mining activities in Cyprus during the last six months of 1936.

The pronounced recovery in mining activity witnessed during the first six months of 1936 was well maintained in the latter half of the year. The output of cupreous pyrites reached a new record, and an increased tonnage of cupreous concentrates was exported during the period.

A dry autumn enabled operations at the asbestos quarries to be continued until well into November, which partly compensated for the low production in the first six months of the year.

Interest in prospecting was undiminished, and in consequence of several gold discoveries there was a great demand for prospecting permits. Four new mining leases were granted, chiefly for precious metals, three of which reached the production stage during the period under review.

Mineral Production

	Last 6 months 1936.	Last 6 months 1935.
	Tons.	*Tons.*
Cupreous pyrites (dry weight)		
Skouriotissa Mine, production	112,586	69,082
,, ,, exported	96,256	62,817
Mavrovouni Mine, production	193,426	138,407
,, ,, exported	24,030	70,050
Cupreous concentrates (dry weight)		
Mavrovouni ore, exported	31,932	Nil
Cement copper		
Mavrovouni ore	Nil	170
Chrome iron ore		
Production	Nil	974
Gold (contained in ores, concentrates and precipitates)	*Troy oz. fine.*	
Skouriotissa Mine	Nil	2,791
Mathiati Lease	Nil	9,557
Akoliou Lease	Nil	79
M.W. Berdy Lease	Nil	627
Prospecting Permit Areas	Nil	33

	Last 6 months 1936.	Last 6 months 1935.
Silver (contained in ores, concentrates and precipitates)	*Troy oz. fine.*	
Skouriotissa Mine	Nil	15,905
Mathiati Lease	Nil	55,411
Akoliou Lease	Nil	279
M.W. Berdy Lease	Nil	3,229
Prospecting Permit Areas	Nil	189
Asbestos (Tunnel Asbestos Cement Co., Ltd.)	*Tons.*	*Tons.*
Rock mined	936,370	340,862
,, treated	188,953	73,945
Asbestos fibre produced	6,123	3,722
,, ,, exported	6,209	3,221
Other minerals exported		
Gypsum calcined	2,851	2,212
,, raw	3,668	5,898
Stone, building, cu. yds.	79	2
,, pumice	223	1,056
Terra umbra	2,252	3,579
,, verte	8	3

The following table shows the production and export of certain minerals for the year 1936:—

	Production.	Export.
Chrome iron ore, tons	Nil	Nil
Copper, metallic, tons (*a*)	16,351	16,351
Gypsum, calcined, tons	Nil	4,910
,, raw, tons	13,000	11,430
Gold, troy oz. fine	(*b*)	20,991
Silver, troy oz. fine	(*b*)	125,704

(*a*) *Estimated copper content of cupreous pyrites and cupreous concentrates.*

(*b*) *Information not available.*

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PLANT AND ANIMAL PRODUCTS

AGRICULTURE

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Geología del Petróleo en el Norte de Marruecos. By J. L. Pastora. *Bol. Ofic. Dir. Gen. Minas y Comb., Madrid*, 1936, **20**, 671-676.

Application du Système "Rotary" dans les Champs pétrolifères et de Gaz de l'Est des Etats-Unis. By E. V. O'Rourke. *Rev. Industr. min.*, 1937, No. 390, 164-167.

Possibility of new Oil Pools in the Siliceous Lime and Bartlesville Sand in T. 23 N., R. 10 E., Osage County, Oklahoma. By N. W. Bass, W. R. Dillard, and J. H. Hengst. *Bull. No.* 886-A, *U.S. Geol. Surv.* Pp. 4, 9 × 6. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1936.) Price 5 cents.

Engineering Report on Oklahoma City Oil Field, Oklahoma. By H. B. Hill, E. L. Rawlins, and C. R. Bopp. *Rep. Invest. No.* 3330, *U.S. Bur. Mines.* Pp. 244, 10½ × 8, and maps. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1937.)

Growing Importance of Near and Middle East Oil. *Petrol. Times*, 1937, **37**, 186-193.

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A Study of Chrome-Alumina Bricks. Part I. By T. R. Lynam and W. J. Rees. *Trans. Ceram. Soc.*, 1937, **36**, 110-132.

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Mixtures of Chromite and Grecian Magnesite. Part I. By T. R. Lynam and W. J. Rees. *Trans. Ceram. Soc.*, 1937, **36**, 137-151.

Mixtures of Chromite and Grecian Magnesite. Part II. By T. R. Lynam and W. J. Rees. *Trans. Ceram. Soc.*, 1937, **36**, 152-172.

Sulphur

Flotation of Pyrite. By H. W. Gartrell. *Chem. Engng. Min. Rev.*, 1937, **29**, 141-144.

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NOTICES OF RECENT LITERATURE

Books for review should be addressed to "The Editor," Bulletin of the Imperial Institute, South Kensington, London, S.W.7.

VEGETABLE CROPS FOR MARKET. By A. H. Hoare. Pp. 198, $8\frac{1}{2} \times 5\frac{1}{2}$. (London: Crosby Lockwood & Son, Ltd., 1937.) Price 7*s*. 6*d*.

It has been estimated that 75 per cent. of the population of England and Wales live in the vicinity of towns and are unable to grow their own supplies of fresh vegetables. Their needs are met by what has become one of the major industries of the country, with an output of fresh vegetables to the value of some £12,000,000 annually, and this exclusive of potatoes and glasshouse crops such as cucumbers and tomatoes. At one time the bulk of the supplies were provided by the intensive market gardens of relatively small area situated close to the towns, but improvements in transport, first the railway and then the motor lorry, enabled the produce to be grown further afield, until now a big proportion is grown under mechanised conditions on large-scale farms.

Mr. Hoare, who is a General Inspector under the Ministry of Agriculture, writes for those who are taking part in the development of this new extensive vegetable farming, as well as for the market gardener in the older sense. After a survey of vegetable production in this country, he passes on to a consideration of the soil, climate, manuring, and tillage; and of seed selection and methods of plant-breeding. Then follow

chapters giving detailed accounts of the cultivation of the various crops and their preparation for the market. The outdoor crops dealt with include the Brassicas, legumes, root crops, salads, and various miscellaneous crops, such as asparagus, celery, rhubarb, mushrooms, and so on. Separate chapters are devoted to early and forced crops involving the use of glasshouses, frames, hand-lights or cloches, and with culinary herbs. Subjects of more general application, such as pests and diseases, containers for market produce, and fertilisers, are dealt with in appendixes.

The book is one of the Agricultural and Horticultural Handbooks issued under the general editorship of Mr. H. C. Long and like previous volumes of the series noticed in this BULLETIN is admirably illustrated. It worthily upholds the high standard reached in the earlier volumes.

CORN AND CORN GROWING. By H. A. Wallace and E. N. Bressman. Fourth Edition. Pp. vii + 436, 8 × 5½. (New York: John Wiley & Sons, Inc., London: Chapman & Hall, Ltd., 1937.) Price 13*s*. 6*d*.

This new and thoroughly revised edition of a work which has a high reputation among agricultural teachers in the United States will be found of considerable interest and value to growers of maize in other countries, who wish to obtain authoritative information on the methods practised in a country which produces nearly half the world's maize crop. It deals with all aspects of the cultivation of the plant, its botany, varieties and genetics, and its commercial products, whilst the economics of the crop are also fully discussed. The latter subject and the genetics of maize have been given special consideration in revising the book.

CANNING PRACTICE AND CONTROL. By Osman Jones, F.I.C., and T. W. Jones, B.Sc. Pp. xii + 254, 9¾ × 6. (London: Chapman & Hall, Ltd., 1937.) Price 25*s*.

This work is not a detailed treatise on the different methods employed for processing individual canned products. It deals rather with the basic principles underlying the whole subject. In other words the aim of the authors has been to compile a book which will furnish that information which is necessary to the canner if he is to put on to the market a properly processed foodstuff. They have deliberately omitted material of a purely academic nature, and have endeavoured to ensure that only subject matter of direct practical service is included. The scope of the work has been further limited by confining it to questions relating to " foodstuffs hermetically

sealed and processed in containers." This includes fruits, fish, vegetables, and meats, but not powders and other dry solids such as biscuits, cocoa, coffee, etc., sealed in tinplate containers, nor does it include foodstuffs processed in glass containers.

As a result of this very commendable restraint, a book has been produced which is both practical and readable and in which the subject matter is well arranged and easily accessible.

In surveying the contents of the book it is convenient to divide the subject matter in four parts. The first after some preliminary statistics comprises two chapters, one which discusses the establishment of a cannery and its equipment and the other deals mainly with general processes involved. This chapter also includes notes on spoilage and a brief but interesting account of the manufacture of tin plate and cans.

The next five chapters, which may be regarded as the second part of the book, relate to the design and layout of the laboratory, the examination of raw foodstuffs, the examination of the can, suitability of water for canning and its analysis, and the examination of canned foods. In keeping with their intention of being strictly practical, the authors have dealt only with substances likely to be handled in the factory, and the analytical methods outlined are those which have been well tried in the canning laboratory and found satisfactory.

Then follows a portion of the book devoted to the bacteriological aspect of canning. This consists of a chapter giving a general outline of the microbiology of canning, and then two more on the preparation and use of culture media and the staining of micro-organisms for microscopical examination, and finally a fourth containing cultural notes on the principal food-spoiling organisms, together with eighteen photo-micrographs.

The remainder of the book deals with such miscellaneous matters as the effect of canning upon nutritive values, cannery waste and cannery hygiene.

The work is illustrated by over seventy photographs and at the end of each chapter will be found a list of articles or publications to which reference has been made in the text.

There was undoubtedly a need for a book of this kind, and it can be thoroughly recommended not only to canners themselves but to everyone interested in the industry.

THE EXTRA PHARMACOPOEIA OF MARTINDALE. Volume I. Pp. xxxiv + 1182, 7 × 4¼. Twenty-first Edition. Published by direction of the Council of the Pharmaceutical Society of Great Britain. (London: The Pharmaceutical Press, 1936.) Price 27*s*. 6*d*.

This edition of Volume I of the "Extra Pharmacopoeia" is the first revision of this volume to be carried out by the

Revision Committee of the Pharmaceutical Society under the editorship of C. E. Corfield. The events leading up to the new system of revision were mentioned in this BULLETIN, 1935, **33**, 520, in connection with a notice of the twentieth edition of Vol. II.

In addition to a slight increase in the size of the volume and the use of new type, which makes it easier to read, the growth in the number of medicinal substances has necessitated a change in the classification and arrangement of the book.

At first glance the reader will be attracted by the vast number of proprietary preparations now in use, and as a new feature the composition of a large number of these is given, based on information supplied by the manufacturers or their agents in this country. Incidentally the book forms a fairly complete directory of such preparations since the name of the maker is given in all cases.

It is impossible in this notice to enumerate all the additions to and the omissions from the previous edition, but it may be said that it is full of up-to-date information, including the most important alterations and additions to the B.P. Addendum. The 1935 Poison Rules are adequately dealt with, and since both the medical practitioner and the pharmacist have now to conform to these regulations it should do much to help in the writing of correct prescriptions.

A study of this volume will impress the reader with the fact that although the book is fundamentally the "Martindale" of the past fifty years, the Revision Committee has certainly added much to its value as a survey of substances used for the treatment of human ailments and diseases.

SOIL CONDITIONS AND PLANT GROWTH. By Sir E. John Russell, D.Sc., F.R.S. Pp. viii + 655, $8\frac{1}{2} \times 5\frac{1}{2}$. Seventh Edition. (London, New York, Toronto: Longmans, Green & Co., 1937.) Price *21s.*

During the period which has elapsed since the first edition of this book appeared, in 1912, the advances in knowledge and the changes in conceptions over the whole field of study of the soil have been remarkably rapid.

It is the author's intention that his book should be read and not simply consulted as a work of reference. In order to keep the reader informed of the rapid advance of knowledge and at the same time keep the book within reasonable compass, it has been necessary to carry out an exceptionally thorough revision. As compared with the previous edition (noticed in this BULLETIN, 1932, **30**, 111), large sections have been rewritten, some being expanded and new matter added, while in other cases less important matter has been omitted.

Among the new material the section on nitrogen nutrition of the plant has been extended; recent work on the importance of very small quantities of certain elements formerly regarded as non-essential, such as boron and zinc, is included; and there is a useful table indicating the appearances in the growing plant corresponding with certain external conditions. In dealing with the composition of the soil, the latest work on theories of clay structure, the mechanism of base exchange, and the properties of soil organic matter is well covered. The section on the water relationships of soil and plant has been extensively revised and includes a new section on the work, particularly of Schofield, on the "capillary potential" or *p*F of the soil.

The deleted matter includes the Appendix on Analytical Methods, now unnecessary as there are special text-books dealing with this branch of soil science. The Bibliography has been somewhat shortened, but this condensation is more than balanced by the numerous references to literature given in the body of the book itself.

The book is keeping abreast of developments, both in fundamental principles and in their application to practical agriculture, and so long as new editions are produced on the same lines it will undoubtedly continue to occupy its deservedly high place in agricultural literature.

ENGINEERING PROPERTIES OF SOIL. By C. A. Hogentogler, C.E. Pp. xiii + 434, 9 × 6. (London: McGraw-Hill Publishing Company, Ltd., 1937.) Price 30*s*.

This book deals with soil from the engineering point of view, and its properties as required for the construction of roads, embankments and dams, as a foundation for buildings, and as an aggregate for bituminous and other mixtures, are considered. In the preface attention is drawn to the fact that though soil is the oldest and probably the most used of engineering materials, yet working knowledge of its structural properties and of the methods for their evaluation has been meagre compared with knowledge of the properties and uses of newer materials such as concrete, steel and brick. The last decade has seen rapid progress in the understanding of the physical phenomena responsible for such properties as shrinkage, capillarity, etc., which control the structural stability of soils. This knowledge, which has assumed a definite and more or less stable form, is here embodied in a text-book.

The first part of the book, dealing with the origin and composition of the soil, covers the subject in a concise manner, neglecting those more academic details that are not entirely relevant.

The second and third parts, devoted to the characteristics and mechanical properties of soil, and the significance of the methods used in its examination, are clearly written and the subjects are considered very fully.

Part four deals, amongst other matters, with the classification of soils for engineering purposes, the construction of stabilised soil roads and with soft-foundation soils. A chapter mainly devoted to testing is also included. This last chapter might with advantage be amplified in succeeding editions and thus render the work still more useful to those not well acquainted with the methods described.

The book concludes with four appendices, dealing with conversion factors, nomenclature, glossary of geological terms, and an explanation of terms used in describing the various layers of the soil profile. There is also a good bibliography of references to relevant literature.

This work, which contains a wealth of useful information, should prove to be a valuable text-book for all those interested in modern methods of road making and constructional engineering.

THE PLANT DISEASES OF GREAT BRITAIN: A BIBLIOGRAPHY. Compiled and Annotated by G. C. Ainsworth, B.Sc., Ph.D. Pp. xii + 273, $8\frac{1}{2} \times 5\frac{1}{2}$. (London: Chapman & Hall, Ltd., 1937.) Price 15*s*.

A compilation of this nature must necessarily be selective if it is to avoid being unwieldy, but Mr. Ainsworth has been able to include in his list all the more important work published in this country. Papers in foreign languages and those which are difficult of access have been omitted, unless of special interest. Brief notes are given with the references to indicate the scope of the papers cited, and wherever possible abstracts published in the *Review of Applied Mycology* are also noted. The notes contain much useful information and add considerably to the value of the book.

Care has been taken in arranging the subject-matter to facilitate reference. The book is divided into sections treating the diseases of cereals, fodder crops, the potato, pulse, vegetables, fruit, ornamental plants, trees and finally miscellaneous plants. The diseases are listed under the host plants, which are arranged alphabetically according to genera within the groups Dicotyledons, Monocotyledons and Gymnosperms, while different diseases of any one host plant are set out according to the botanical status of the causative organisms. There is a good author index, and an index of hosts and parasites in which the names of parasitic organisms are printed in italics.

The book presents a great deal of useful information in a

compact and workable form, and should prove most valuable to all whose work is connected with plant pathology.

METHODS IN PLANT PHYSIOLOGY. By Walter E. Loomis, Ph.D., and Charles A. Shull, Ph.D. Pp. xviii + 472, 9 × 6. (London: McGraw-Hill Publishing Company, Ltd., 1937.) Price 25s.

This book is designed to meet the needs of students, teachers, and research workers, and the wide field is covered thoroughly without assuming an advanced scientific knowledge on the part of the reader. The text is arranged in two parts; the first contains descriptions of laboratory experiments (over 180 are described), while the second part deals with more general methods of procedure likely to be of use to research workers.

The experiments are set out in twelve chapters dealing with the principal topics of plant physiology. In addition to directions for carrying out the experiments, each chapter includes a brief discussion on the work involved, and a short list of books for further study. Experiments suitable for elementary, intermediate, and advanced work are not separated, but are indicated by the letters (E), (I), and (A) respectively.

Part II deals mainly with methods and apparatus used for bio-physical determinations and chemical analyses of plant material, and includes a chapter on the measurement and control of plant environment. The concluding chapter on statistical methods has been contributed by Professor G. W. Snedecor, of Iowa State College, and forms a most useful feature. There follow an appendix of thirty-three tables and the index; the former gives physical and chemical data required in the experiments described. The usefulness of the book is greatly enhanced by its wealth of practical detail throughout.

MILK PRODUCTS. By Wm. Clunie Harvey, M.D., D.P.H., M.R.San.I., and Harry Hill, M.R.San.I., A.M.I.S.E., M.S.I.A. Pp. viii + 387, 8½ × 5½. (London: H. K. Lewis & Co., Ltd., 1937.) Price 16s.

This work is complementary to one on *Milk Production and Control* by the same authors published last year (see this BULLETIN, 1936, **34**, 426). Like that book it is written particularly for the benefit of municipal officials and others concerned in the administration of Public Health matters, but it will be found useful to all who wish to obtain information as to how dairy products are made and as to the scientific control that is necessary to ensure their purity and value.

The ordinary reader may be surprised to find that the opening chapter, and the longest in the book (84 pages) is

concerned with ice cream, but 20 of these pages are devoted to a summary of the legislation in force in various countries of the world to control the manufacture and sale of this product, which will indicate the important place ice cream now occupies amongst milk products. Subsequent chapters deal with cream, butter and margarine, cheese, condensed milk, evaporated milk, dried milk, and subsidiary milk products, such as fermented milks, dried whey, lactose, infant foods, casein, etc. One drawback to the book is the almost complete absence of references to literature, both as to the sources from which the authors have drawn their information (apart of course from the various Acts and Regulations mentioned) and as to publications from which more detailed particulars might be obtained. There must be many readers whose appetite has been whetted by the book who would wish to take up the subject further.

MILK AND MILK PRODUCTS. By Clarence Henry Eckles, D.Sc., Willes Barnes Combs, M.A., and Harold Macy, Ph. D. Second Edition. Pp. xiii + 386, 9 × 6. (London: McGraw-Hill Publishing Co., Ltd., 1936.) Price 21*s.*

The authors of this text book for agricultural college students are or have been attached to the Dairying Department of the University of Minnesota and the experience thus gained in teaching the subject has enabled them to produce a book which should be of great assistance to those commencing a course in dairying. A knowledge of elementary chemistry is assumed but the bacteriological aspect is dealt with from the commencement. The composition and properties of milk and the factors which influence these characteristics, including the microbiology of milk, are fully discussed. Having mastered these fundamentals, the student is in a position to understand better the processes of handling liquid milk and the manufacture of butter, cheese, ice cream, condensed and dried milk and other milk products, all of which are concisely dealt with in succeeding chapters. There are chapters on "Dairy Arithmetic" and on miscellaneous tests used in the dairy laboratory and the book closes with an appendix containing useful tables and the official A.O.A.C. methods for fat determination.

A PRACTICAL COURSE IN AGRICULTURAL CHEMISTRY. By Frank Knowles, F.I.C., and J. Elphin Watkin, B.Sc., Ph.D., A.I.C. Pp. ix + 188, 8½ × 5½. (London: Macmillan and Co., Ltd., 1937.) Price 10*s.*

This book, to which Sir John Russell has contributed a foreword, is intended primarily to meet the requirements of

students of agriculture, dairying, horticulture, and poultry husbandry preparing for a science degree or diploma in those subjects. Its object is to furnish them with a practical course of laboratory work in agricultural chemistry by the following of which they may acquire experimentally knowledge concerning the materials met in the particular branches of science in which they are interested. For this purpose, under the headings of soils, fertilisers and manures, plant and animal bio-chemistry, feeding stuffs, dairy products, water, insecticides and fungicides, experiments are described to illustrate the properties of the materials dealt with, methods for their quantitative examination are given and qualitative tests are included for the detection of the presence of various constituents. The authors have explained the processes performed and, in addition, have shown the relation of the experiments to the whole subject, thus indicating the bearing of the laboratory exercises on farm and field practice.

The course is well planned and comprehensive, and the book should prove of value to those for whom it was written.

Laboratory Methods of Organic Chemistry. By L. Gattermann, completely revised by Heirrich Wieland. Translated from the Twenty-fourth German edition by W. McCartney, Ph.D., A.I.C. Pp. xvi + 435, $8\frac{3}{4} \times 5\frac{3}{4}$. (London : Macmillan & Co., Ltd., 1937.) Price 18*s*.

The fact that this well-known text-book of practical organic chemistry, first published in German over forty years ago, has now reached its twenty-fourth edition is evidence of the popularity of the work. With the exception of the section dealing with the analytical methods employed in organic chemistry, which has been completely rewritten, the present edition is almost identical with its predecessor. Small additions have, however, been made, these including analyses by chromotographic adsorption and ozonisation of unsaturated compounds, whilst the chapter devoted to diazo-compounds has been somewhat enlarged.

In the organic analysis section the well-established macro methods have been entirely replaced by the semi-micro or mezo-analytical methods, worked out by Pregl and others, which require smaller amounts of material. Although it will be generally admitted that these latter methods are admirable, it is doubtful whether the complete abandonment of the older macro methods, in favour of those requiring a more elaborate technique, is altogether desirable. Some, such as the simple Zeisel method for the determination of the methoxyl group, might well have been retained.

There is one small matter open to criticism which might

be remedied in later editions. When dealing with the prevention of accidents it is stated that " slight burns should be washed with alcohol and then covered with linseed oil or an ointment." The use of oil or grease for burns is not advocated now as this limits the treatment a doctor is able to apply subsequently, should his services prove necessary.

MINE ECONOMICS. Sampling—Valuation—Organisation. By S. J. Truscott. Pp. ix + 335, 8¾ × 6. (London: Mining Publications, Ltd., 1937.) Price 21*s*.

This useful book, which represents substantially the subject-matter of a series of lectures given by the author at the Royal School of Mines, is intended primarily for students, but should also prove of value to mining engineers generally.

The work is divided into three main sections dealing with mine sampling (109 pp.), mine valuation (22 pp.), and mine organisation (99 pp.). In addition, there is an extensive appendix (58 pp.) giving tables of annuities and sinking fund instalments, and also a selection of typical balance sheets, profit and loss accounts, appropriation accounts, etc., arranged in alphabetical order with regard to the names of certain well-known mining companies.

The section on sampling is particularly comprehensive, discussing all types of samples, whether underground, surfacial or alluvial, and giving details of methods of obtaining samples and of computing the tonnages and assay values of mineral deposits. This account is followed logically by a section on mine valuation, which, although comparatively brief, discusses mineral reserves, mining costs, beneficiation and marketing of ores, and the drafting of professional mining reports.

The third section describes the various types of mining companies, their capitalisation, and formation. Observations are made here regarding annual reports, balance sheets, profit and loss accounts, changes in capitalisation, mine accountancy, labour, stores, and management.

The work is illustrated by means of diagrams and plates, and concludes with a good index.

THE METALLURGY OF GOLD. By Sir Thomas Kirke Rose, D.Sc., and W. A. C. Newman, B.Sc., F.I.C. Pp. xiii + 561, 8¾ × 6. Seventh Edition, revised throughout and reset. (London: Charles Griffin & Company, Ltd., 1937.) Price 36*s*.

The last edition of this valuable book, published in 1915, having been out of print for some years, this new edition is both called for and welcome. So many changes and developments in the metallurgy of gold have taken place since 1915

that the authors must have found the task of revision a formidable one.

Although the seventh edition is roughly the same size as the last it is virtually new throughout, nearly all those sections that have been retained having been rewritten. Matter that had become obsolete or of historical interest only, for example, the chapter on chlorination, has been deleted and replaced by new chapters, such as those on ore-testing and flotation—the latter a comparatively recent application in the treatment of gold ores.

Much new matter has been added concerning amalgamation, fine grinding, classification, gravity concentration and cyaniding, and, as would be expected from these authors, the chapter on the assay of ores and the melting and assaying of gold bullion are of exceptional value.

One chapter, giving complete descriptions with treatment charts of modern gold-recovery plants and their operation in different parts of the world, would prove of great interest to the gold reduction officer.

The value of the book is enhanced by a large number of good photographs, diagrams and drawings of all kinds of gold metallurgical plant. The book itself is a very fine piece of work, a credit both to authors and publishers.

CYANIDATION AND CONCENTRATION OF GOLD AND SILVER ORES. By John V. N. Dorr, E.M., D.Sc. Pp. ix + 485, 9 × 6. (London: McGraw-Hill Publishing Company, Ltd., 1936.) Price 30s.

The author of this book, who has been assisted by a few collaborators, is well known as the inventor of classifying, slime thickening, agitation and filtering machinery, that has done so much to revolutionise gold recovery by the cyanide process in the last 30 years and recently has become essential in many other branches of industry.

The first of the fifteen chapters of the book is historical in character, as regards the cyanide process and its development, and concludes with statistics of gold output of the 167 chief gold mines throughout the world for the years 1929 to 1935. The next chapter, a particularly good one on the examination and testing of ores, is followed by others on coarse crushing, sorting, fine-grinding in open or closed circuit, classification and its uses, sand and slime treatment, including thickening and filtration, concentration by gravity and flotation methods, gold recovery by amalgamation, various methods of precipitation and control of plant operation.

Two-fifths of the text is devoted to descriptions of a large number of modern plants, treating both simple and complex

gold ores, which will prove of great interest to students of gold recovery. The last chapter of 27 pages is a compendium of information useful to the metallurgist and to the mining engineer.

The book is copiously illustrated and is a worthy addition to the publishers' excellent series of technical works.

ALUMINIUM PAINT AND POWDER. By Junius David Edwards. Pp. 216, 9 × 6. Second Edition, revised and enlarged. (New York: Reinhold Publishing Corporation; London: Chapman & Hall, Ltd., 1936.) Price 22*s*. 6*d*.

This useful second edition of a work published about 10 years ago has been completely rewritten and very substantially increased in size. Much of the technical information now presented is attributed to the author's associates in the Aluminium Company of America, especially to R. I. Wray, chief of the Paints and Finishes Division of the Aluminium Research Laboratories.

Following the current practice in paint technology, the author applies the terms " aluminium powder " and " aluminium bronze powder " synonymously to the lustrous, fluffy and flake-like form of pure aluminium, as distinct from the dull and sometimes grey or black powders produced by various atomising and pulverising methods. Although this terminology may sometimes be misleading to metallurgists who are unfamiliar with the bronze powder art, very little confusion is usually encountered in this respect in the trade.

The book deals with the manufacture, properties, examination, and uses of aluminium powder, and the composition, properties and uses of aluminium paints, particularly as a protection for metals and wood. An appendix giving the specifications for aluminium paint vehicles is also provided, the vehicles considered being long oil varnish, phenolic resin base varnish, glycerol phthalate resin base varnish, interior varnish, and very long oil varnish.

It is illustrated by 78 plates and graphs, in addition to 19 statistical tables, and may be well recommended as an authoritative and excellent treatise on aluminium paint and powder.

CORROSION RESISTANCE OF METALS AND ALLOYS. By Robert J. McKay and Robert Worthington. Pp. 492, 9 × 6. (New York: Reinhold Publishing Corporation; London: Chapman & Hall, Ltd., 1936.) Price 35*s*.

The study of corrosion, a wide and diversified problem affecting almost every industry, has been treated in this book in a manner calculated to enable defects due to this

cause to be readily diagnosed and eliminated by the choice of suitable materials. The publication is one of the Monograph Series issued by the American Chemical Society.

Part I, consisting of four chapters, deals with factors affecting the rate with which corrosion proceeds, forms of corrosion, corrosive agents, and the susceptibility of particular metals to corrosion.

The factors which influence the rate of corrosion are considered first from chemical, then from physical aspects, and include such generally understood effects as acidity, oxidation, electrolysis and temperature, but there is no mention of pressure phenomena which have given rise to serious difficulties in the construction of hydrogenation plants, and which influence marine screw design to a large extent. In discussing the forms of corrosion, special attention has been devoted to the solution-cell type with regard to the pitting of iron, and the chapter on corrosives covers a wide range of such agents, including soils and foodstuffs. A number of useful illustrations are incorporated, particularly in the last chapter of this part of the book.

Part II, which deals with the behaviour of specific metals and alloys towards corrosion, commences with a table of corrosion rates expressed in mgm. per $dm.^2$ per day, for acidic, alkaline, freshwater, marine, and urban atmospheric conditions for a number of metals and alloys. These are at best, however, only very roughly approximate and of wide range. Useful tables of strength and ductility, and other physical constants of metals are also given in this section.

The remaining chapters which form the bulk of the book deal with many metals and alloys arranged according to their susceptibility to corrosion. Magnesium and its alloys are dealt with first and the high-copper alloys last.

An interesting case is made out in support of the use of aluminium for cooking utensils, both from the standpoint of resistance to ordinary corrosion and of non-toxicity of the resulting aluminium salts, but the statement on p. 136 that "aluminium is a normal constituent of food and that the further quantities absorbed from the utensil in normal use are not significant" lacks conviction when reference is made to the table on p. 135 which shows the amount of aluminium picked up by various foods cooked in vessels of this metal.

Throughout the book graphs and other statistical data relating to experimental work on corrosion are profusely employed, and each chapter has a useful bibliography.

Unusual features in a book of this kind are the pen and ink sketches of "Old Man Corrosion," a fiendish creature appearing on p. 4 and again at the conclusion of each chapter, in some relevant situation.

The book concludes with valuable author and subject indexes covering the many aspects of corrosion which have merited attention.

INDUSTRIAL DUST: HYGIENIC SIGNIFICANCE, MEASUREMENT, AND CONTROL. By Philip Drinker, S.B., Ch.E., and Theodore Hatch, B.S., S.M. Pp. viii + 316, 9 × 6. (New York: McGraw-Hill Book Company, Inc.; London: McGraw-Hill Publishing Co., Ltd., 1936.) Price 24s.

Considerable attention has been paid in recent years to the study of dust in industry and to its harmful effects upon the human system, so that the present work, dealing in part with the engineering design and operation of dust-control equipment, will doubtless be welcomed by engineers and by all interested in the subject generally.

After an introductory chapter on the physical properties of dusts, fumes, and mists, the authors proceed to describe the effects of these on man, enlarging upon such occupational diseases as silicosis, asbestosis, metal-fume fever, and allergic reactions like hay-fever and certain specific kinds of skin eruptions. Tables are given showing the number of persons engaged in the United States in trades involving more or less exposure to silica dust, and, after a discussion, it is computed that approximately 500,000 workers are exposed to harmful amounts of silica dust and 10,000 to asbestos dust.

The problem of the amount of dust that may be allowed in industry is considered in detail, and the conclusions on this subject may be summarised as follows:

Permissible dust concentrations in industry.

	Particles per cu. ft. of air.
Silica dust	5 million
Coal dust with 5 per cent. quartz	50 „
„ „ „ 13 „ „	10 to 15 million
„ „ „ 35 „ „	5 to 10 „
Cement and limestone dust	10 to 20 „
	Mg. per cu. metre of air.
Lead dust (litharge and white lead)	0·15 to 0·5 mg.
Zinc oxide (in terms of metal)	14 to 45 mg.
Manganese dust (in terms of metal)	50 mg.

The authors maintain that, as a rough guide, a total silica content as high as 0·2 per cent. of dried lung may be considered normal, 1 per cent. or more constituting strong evidence of excessive dust exposure and disabling fibrosis.

Descriptions are given of apparatus for the determination of the amount of dust by various methods depending on settlement, filtration, washing, impingement, electrical precipitation and thermal precipitation. The particle size of such

material may be determined by one or other of the methods enumerated (e.g., screen analysis, micrometric measurement, elutriation, or by means of the ultra-microscope), while the chemical and mineralogical composition may be ascertained according to the principles set out in Chapter 9. Unfortunately, the method described in this chapter for distinguishing between free silica and silicates in dust by treating the latter with hydrofluosilicic acid has been shown by C. B. Moke to be of little value.

The concluding chapters are particularly informative and deal with the design of local exhaust systems, air-cleaning apparatus, dust respirators, and air masks.

The work is illustrated by means of 104 figures, including diagrams, tables, and half-tone plates, that depicting the lungs, bronchi, and trachea being especially effective. Some 260 references are listed in the bibliography at the end of the work, which may be regarded as a well-devised and useful contribution to a difficult but important subject.

BOOKS RECEIVED FOR NOTICE

Moisture and Farming in South Africa. By W. R. Thompson. Pp. 260, $8\frac{1}{2} \times 5\frac{1}{2}$. (South Africa: Central News Agency, Ltd.; London: Gordon & Gotch, Ltd., 1936.) Price 21*s*.

A Survey of Current Bibliographies on Agriculture and Allied Subjects. Pp. 84, $9\frac{1}{2} \times 6\frac{1}{2}$. (Rome: International Institute of Agriculture, 1937.) Price 10 *Lire*.

Farm Machinery and Equipment. By Harris Pearson Smith, M.S. Pp. xiii + 460, 9×6. Second Edition. (London: McGraw-Hill Publishing Company, Ltd., 1937.) Price 18*s*.

Scientific Horticulture. The Journal of the Horticultural Education Association. Vol. X, 1937. Pp. xxxii + 196, $9\frac{1}{2} \times 6$. (The Editor, "Scientific Horticulture," S.E. Agricultural College, Wye, Kent.) Price 3*s*. 6*d*. net, postage 5*d*. extra.

The Horticultural Note Book. A Manual of Practical Rules, Data, and Tables. Compiled by J. C. Newsham, F.L.S., F.R.H.S. Pp. xx + 418, $6\frac{3}{4} \times 4\frac{1}{4}$. Fifth Impression. (London: The Technical Press Ltd., 1937.) Price 7*s*. 6*d*.

ORCHARD AND SMALL FRUIT CULTURE. By E. C. Auchter and H. B. Knapp. Pp. xxi + 627, 9 × 6. Third Edition. (New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd., 1937.) Price 25*s.*

THE CACAO INDUSTRY OF TRINIDAD. Some Economic Aspects. By C. Y. Shephard. Series II. A Financial Survey of Estates during the Seven Years 1923-24 to 1929-30. Pp. 30 + 2 Appendices + 9 Tables + 2 Maps + 43 Figs. Series III. An Examination of the Effects of Soil Types and Age on Yield. Pp. 50 + 4 Appendices + 25 Maps + 46 Figs. Series IV. Recommendations for Improving the Efficiency of Estates. Pp. 22 + 2 Appendices. 11 × 8½. (Trinidad: The Government Printer; The Editor, *Tropical Agriculture*, Imperial College of Tropical Agriculture.) Price, Series II, 3*s.*; Series III and IV, bound together, 4*s.* 6*d.*

MACHINERY AND EQUIPMENT OF THE CANE SUGAR FACTORY. By L. A. Tromp. Pp. xii + 644, 9¾ × 6½. (London: Norman Rodger, 1936.) Price 30*s.*

LEGUMINOUS FORAGE PLANTS. By D. H. Robinson, Ph.D., B.Sc., N.D.A. Pp. vii + 119, 8¾ × 5¾. (London: Edward Arnold & Co., 1937.) Price 6*s.*

WORLD COTTON PRODUCTION AND TRADE. Studies of the Principal Agricultural Products on the World Market, No. 1. Pp. xii + 462, 9½ × 6¾. (Rome: International Institute of Agriculture, 1936.) Price 30 *Lire.*

SYNTHETIC RUBBER. By W. J. S. Naunton. Pp. xvi + 162, 8½ × 5½. (London: Macmillan & Co., Ltd., 1937.) Price 7*s.* 6*d.*

THE MANUFACTURE OF PULP AND PAPER. Volume III. Properties of Pulpwood; Preparation of Pulpwood; Manufacture of Mechanical, Sulphite, and Alkaline Pulps; Treatment of Pulp; Bleaching of Pulp; Testing of Pulp. Prepared Under the Direction of the Joint Executive Committee on Vocational Education Representing the Pulp and Paper Industry of the United States and Canada. By Various Authors. Pp. xiii + 927, 9 × 6. Third Edition. (London: McGraw-Hill Publishing Co., Ltd., 1937.) Price 36*s.*

DIRECTORY OF PAPER MAKERS OF GREAT BRITAIN AND IRELAND FOR 1937. Pp. xix + 307, $10\frac{1}{4} \times 7\frac{1}{4}$. (London: Marchant Singer & Co., 1937.) Price 5*s*.

THE PRESERVATION OF IRON AND STEEL BY MEANS OF PAINT. By L. A. Jordan, D.Sc., A.R.C.Sc., F.I.C. and L. Whitby, Ph.D., M.Sc., F.I.C. Sixteenth Bulletin, The Research Association of British Paint, Colour, and Varnish Manufacturers. Pp. 68, $8\frac{1}{2} \times 5\frac{1}{2}$. (Teddington, Middlesex: Paint Research Station.) Price 2*s*. 6*d*.

CHEMICALS IN WAR. By A. M. Prentiss, Ph.D. Pp xviii + 739, 9×6. (New York and London: McGraw-Hil Book Co., Inc., 1937.) Price 45*s*.

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REPORTS OF RECENT INVESTIGATIONS AT THE IMPERIAL INSTITUTE

Selected from the Reports made to the Dominion, Indian, and Colonial Governments

NUTMEGS FROM GRENADA

As was indicated in an article on "The Nutmeg Industry," published in this BULLETIN, 1933, **31**, 197-218, considerable attention is being paid to the improvement in the quality of the nutmegs shipped from Grenada, which, in general, are inferior to those from the Dutch East Indies. In this connection the Governor of the Windward Islands, through the Colonial Office, arranged that samples from two shipments of Grenada nutmegs sent for sale in London last year, and produced on different estates, should be submitted to the Imperial Institute for examination in order to determine their value in comparison with Dutch East Indian nutmegs. The detailed reports on the two series of samples which were furnished by the Imperial Institute are printed below.

SERIES I

This consisted of two samples, representative of a shipment

forwarded in April-May 1936 for sale in London. The samples had been drawn from the shipment under the supervision of an officer of the Imperial Institute. One was from a lot of seven boxes labelled "56s" and the other from a lot of 68 boxes labelled "65s"; the actual wharf counts were 57s and 70s respectively. The 75 boxes comprising the shipment were of light plywood and contained 60 lb. of nutmegs each.

Description

In each case the nutmegs were mostly of good pale colour, but a few were dark and stained. Not many "long" or "semi-long" nutmegs were present. Two commercial samples of "Penang 65s" nutmegs (from the Dutch East Indies) obtained for comparison contained no "longs" and were practically free from stains.

The dimensions, average weight, and actual number per lb. of the Grenada nutmegs, and of the "Penang" samples referred to, were found to be as follows:—

	Present samples.		"Penang 65s."	
	57s.	70s.	(a).	(b).
Length, in inches—				
Maximum	1·5	1·3	1·3	1·2
Minimum	0·85	0·9	1·0	0·95
Average	1·11	1·06	1·1	1·1
Greatest breadth, in inches—				
Maximum	0·9	0·85	0·95	0·95
Minimum	0·75	0·75	0·8	0·8
Average	0·87	0·80	0·86	0·86
Average weight, in grams	7·8	6·6	7·0	6·8
Number per lb.—				
Average	58	69	65	67
Range*	48-72	57-83	50-73	57-76

* *This figure was obtained by sorting the nuts according to weight and separating two quantities each equal to one-tenth of the weight of the entire sample, one-tenth part containing the heaviest and the other the lightest kernels. The number of kernels per lb. in these two portions affords a measure of the uniformity of the sample.*

Remarks on the Commercial Quality of the Samples

The present samples labelled "56s" and "65s" were actually, both by the wharf count and by the count made at the Imperial Institute, "57s" and "70s." As these counts do not meet the main requirements of the United Kingdom buyers, consignments such as the present one would not be

readily saleable. The chief demand on this market at present is for "80s," which size is freely obtainable from the Dutch East Indies. There is also a limited demand for "64s," which are taken by the high-class grocery trade, and for "110s" for grinding. There is no definite market in the United Kingdom for other sizes, which, so far as East Indian nutmegs are concerned, are disposed of in other countries.

Attention must also be called to the divergence in actual count from the stated count in the description of one of the parcels, which proved to be "70s" instead of "65s." It is important from a trade point of view that the stated count should be reliable.

The variation in the size of nuts comprising each of the present samples is rather excessive. From the range given above for Penang "65s," it will be seen that one sample gave the figures 50 to 73, and the other 57 to 76. The Grenada samples showed more variation, having the ranges 48 to 72 and 57 to 83 respectively.

With regard to shape, the present samples contained "long" nuts. These should not be included in consignments of "rounds," but marketed separately. Long nuts are regarded unfavourably by consumers and are considered to be of lower quality.

Chemical Examination

From consultation with the trade it would appear that it is not the general practice to take into consideration the relative "spiciness" of West and East Indian nutmegs in fixing their commercial value. Spice merchants are more concerned with the general appearance, size, shape, and colour of the nuts, and on these features the price would appear to depend.

It was, however, considered desirable to ascertain what differences, if any, exist between the chemical composition of East Indian nutmegs and of those grown in Grenada, and to compare the characters of the volatile oils contained in the respective products. Essential oil of nutmeg is a well-established commercial commodity.

The Grenada nutmegs and the sample of "Penang 65s"

mentioned above were therefore analysed, with the following results :—

	Present samples.		"Penang 65s."	
	57s.	70s.	(a).	(b).
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Moisture	8·3	8·3	8·0	8·2
Volatile oil	11·2	11·2	5·5	6·3
Fixed oil	33·9	34·3	34·3	35·0

Thus, whilst the amounts of fixed oil in all four samples were similar, the present Grenada samples contained about twice as much volatile oil as the commercial Penang nutmegs used for comparison.

The volatile oils obtained from these samples by steam distillation had the following constants, which are shown in comparison with ranges of corresponding figures recorded for nutmeg oil and with the requirements of the British Pharmacopoeia :—

	Specific Gravity at $15{\cdot}5°/15{\cdot}5°$ C.	Optical Rotation α_D.	Refractive Index $n_{D}20°$ C.	Solubility in 90 per cent. alcohol at $15{\cdot}5°$ C.
Present samples :				
57s	0·8666	$+48{\cdot}70°$ at 25° C.	1·4728	Soluble in 4 vols. with slight opalescence.
70s	0·8682	$+48{\cdot}4°$ at 24° C.	1·4736	Soluble in 4 vols. with slight opalescence.
"Penang 65s" :				
(a)	0·9168	$+20{\cdot}32°$ at 26° C.	1·4855	Soluble in 2·1 vols.
(b)	0·9206	$+20{\cdot}19°$ at 25° C.	1·4858	Soluble in 1·6 vols.
Recorded figures for commercial nutmeg oil British Pharmacopoeia	0·865 to 0·925	$+8°$ to $+30°$	1·479 to 1·488	Soluble in 0·5 to 3 vols.
requirements for oil of nutmeg . .	0·880 to 0·925	$+10°$ to $+30°$	1·474 to 1·488	Soluble in 3 vols.

The foregoing figures show that the constants of the volatile oils obtained from the two present samples of Grenada nutmegs are similar, but that they differ considerably from those obtained for the two oils distilled from the commercial East Indian nutmegs. The characters of the latter oils agree with those recorded for commercial oil of nutmeg, and with the standard specified by the British Pharmacopoeia for oil of nutmeg for pharmaceutical purposes.

Although the present Grenada samples yielded more

volatile oil than the Penang nutmegs, the odour of the latter oil was superior, being stronger and more spicy. This is largely due to the fact that, as indicated by the constants, these Grenada oils contained a much larger amount of terpenes, which do not contribute to the spice value of the oil.

General Conclusions

The present samples of nutmegs fall short of the trade requirements in respect of grading and marketing. Their value would be increased by strictly conforming to the stated counts and by separating the round nutmegs from the longs.

Further, the volatile or essential oil, to which the spicy nature of the nutmegs is due, differs in character from that present in East Indian nutmegs.

SERIES II

This series consisted of four samples of " Felix Choice " nutmegs, representative of a shipment forwarded in June 1936 for sale in London. The samples had been drawn from the shipment by the firm of merchants handling the consignment. They were labelled as follows :—

1.	Felix Choice,	64s,	1 case.
2.	,, ,,	80s,	5 cases.
3.	,, ,,	90s,	3 ,,
4.	,, ,,	110s,	5 ,,

The cases were stated to be venesta boxes, weighing 60 lb. each when packed for shipment.

Description

1. *Felix Choice* 64s.—These nutmegs were of good pale colour and were satisfactorily free from " longs." They were only slightly stained, and in general the staining was confined to the ends of the kernels. Except that they were rather more oval in shape, these nutmegs compared well with a similar grade of commercial Dutch East Indian (" Penang ") nutmegs.

2. *Felix Choice* 80s.—These nutmegs were of good pale

colour, and satisfactorily free from "longs" and stains. They were, moreover, only very slightly more oval than "Penang" 80s, and were in other respects at least equal in quality to the commercial sample of the latter product.

3. *Felix Choice* 90s.—These nutmegs were also of good colour, only slightly stained, and free from "longs." Their general appearance showed them, however, to be rather more noticeably oval in shape than either of the foregoing samples.

4. *Felix Choice* 110s.—These kernels resembled the "Felix Choice 90s" in that, although they were of good colour, satisfactorily free from "longs," and only slightly stained, the oval shape of the kernels was more marked.

The dimensions, average weight and actual number per lb. were determined for the present samples and are set out in the following table, which also includes for comparison the corresponding figures for three commercial samples of Dutch East Indian ("Penang") nutmegs and for the two samples of Grenada nutmegs previously received (Series I).

	Grenada Nutmegs.						Dutch East Indian ("Penang") nutmegs.		
	Series II.				Series I.**				
	64s.	80s.	90s.	110s.	57s.	70s.	65s. (a)	65s. (b)	80s.
Length, in inches									
Maximum	1·25	1·25	1·2	1·1	1·5	1·3	1·3	1·2	1·2
Minimum	1·0	0·95	0·9	0·85	0·85	0·9	1·0	0·95	0·95
Average	1·14	1·07	1·04	0·98	1·11	1·06	1·10	1·10	1·05
Greatest breadth, in inches									
Maximum	0·9	0·85	0·85	0·75	0·9	0·85	0·95	0·95	0·95
Minimum	0·8	0·75	0·70	0·6	0·75	0·75	0·8	0·8	0·75
Average	0·84	0·81	0·78	0·71	0·87	0·80	0·86	0·86	0·84
Average weight, in grams	7·2	5·6	5·2	4·2	7·8	6·6	7·0	6·8	5·8
Number per lb.									
Average	63	81	88	107	58	69	65	67	78
Range*	55 to 70	72 to 95	76 to 101	92 to 126	48 to 72	57 to 83	50 to 73	57 to 76	65 to 91

* *This figure was obtained by sorting the nuts according to weight and separating two quantities each equal to one-tenth of the weight of the entire sample, one-tenth part containing the heaviest and the other the lightest kernels. The number of kernels per lb. in these two portions affords a measure of the uniformity of the sample.*

** *These samples were exported as "56s" and "65s" respectively, but after inspection at the London wharf were classified as "57s" and "70s."*

Remarks on the Commercial Quality of the Samples

The present samples represented well sorted and graded West Indian nutmegs of good quality; they were all of good colour, free from "longs," and undamaged by bruising. They exhibited the rather oval shape common to West Indian nutmegs. This was more evident in the case of the 90s and 110s; the 80s did not differ greatly from East Indian 80s in their shape.

It will be seen from the foregoing table that the counts were reasonably reliable, the maximum divergence being the 3 units between the nominal "110s" and their actual count of 107. Furthermore, the figures for the ranges indicate that the present samples were quite as well sorted as commercial Dutch East Indian nutmegs.

As mentioned in the report on Series I, at present the chief demand on the United Kingdom market is for 80s, but 64s, for which there is a limited demand in the high-class grocery trade, and 110s, are also recognised grades. Thus three of the present four samples are desirable grades. For 90s there exists no definite market in the United Kingdom, and, in consequence, nutmegs of this count may not be readily saleable.

Chemical Examination

In connection with the previous two samples of Grenada nutmegs an investigation had been started at the Imperial Institute in order to ascertain what differences, if any, exist between the chemical composition of East Indian nutmegs and of those grown in the West Indies. In continuance of this work it was thought desirable to make a chemical examination of two of the present samples, and for this purpose the 64s and the 110s were selected.

The essential oils were obtained from the ground kernels by steam distillation. On analysis the oils gave the results shown in the following table, which includes for comparison the figures obtained for previous samples of both East Indian and Grenada nutmegs examined at the Imperial Institute, Gildemeister's figures for commercial nutmeg oil and the British Pharmacopoeia specifications for nutmeg oil:—

	Grenada Nutmegs.				Dutch East Indian ("Penang") nutmegs.			Nutmeg Oil (Gildemeister).	British Pharmacopoeia Specifications for Nutmeg Oil.
	Series II.		Series I.						
	64s.	110s.	57s.	70s.	65s (a).	65s (b).	80s.		
Moisture in kernels . *per cent.*	7·5	9·9	8·3	8·3	8·0	8·2	7·0		
Volatile oil in kernels . *per cent.*	6·5	8·0	11·2	11·2	5·5	6·3	6·1		
Physical constants of the volatile oil: Specific gravity at 15·5°/15·5° C. .	0·8880	0·8752	0·8666	0·8682	0·9168	0·9206	0·9231	0·865 to 0·925	0·880 to 0·925
Optical rotation, α_D	+34·08° at 21° C.	+41·08° at 20° C.	+48·70° at 25° C.	+48·40° at 24° C.	+20·32° at 26° C.	+20·19° at 25° C.	+22·42° at 24° C.	+8° to +30°	+10° to +30°
Refractive index, $n_D 20°C.$	1·4782	1·4757	1·4728	1·4736	1·4855	1·4858	1·4879	1·479 to 1·488	1·474 to 1·488
Solubility in 90 per cent. alcohol at 15·5° C.	Soluble in 2·5 vols.	Soluble in 3·1 vols.	Soluble in 4 vols. with slight opalescence	Soluble in 4 vols. with slight opalescence	Soluble in 2·1 vols.	Soluble in 1·6 vols.	Soluble in 2·0 vols.	Soluble in 0·5 to 3·0 vols.	Soluble in 3 vols.

The yields of oil obtained from the Felix 64s and 110s were 6·5 and 8·0 per cent. respectively. These figures are considerably lower than the 11·2 per cent. of oil obtained from both previous samples of Grenada nutmegs and are almost as low as the yields obtained at the Imperial Institute for commercial samples of Dutch East Indian kernels.

Furthermore, the physical constants of the oils obtained from the Felix nutmegs show that in character these oils more closely approach the oil of East Indian nutmegs than did the previous samples. This is particularly the case with the oil from the 64s which only fails to conform to the British Pharmacopoeia requirements for oil of nutmeg by having slightly too high an optical rotation.

General Conclusions

The present four samples represent West Indian nutmegs of good appearance. With the single exception of the 90s they have been sorted into recognised counts and they are free from "longs" and are undamaged by bruising. They have been sorted and graded as well as Dutch East Indian nutmegs, but the two smaller sizes, viz., the 90s and 110s, differ from the Dutch by being of a definitely more oval shape.

The essential oil was obtained from the 64s and 110s; these samples were found to differ from the previous two samples of Grenada nutmegs recently examined, since in yield and character the oil obtained from them more closely approached the results obtained at the Imperial Institute for commercial Dutch East Indian kernels.

ESSENTIAL OILS FROM SEYCHELLES. II

IN a previous number of this BULLETIN (1934, **32**, 511-539) were published reports on the examination of a large number of essential oils produced in Seychelles, whilst in the same issue (pp. 545-559) appeared a summary of a report by Mr. W. Holdsworth Haines on an investigation of the position of the essential oil industry in the Colony which he undertook in 1932-33. Since that time a considerable amount of work has been carried out by the Department of Agriculture with a view to placing the industry on a securer basis. With the aid of a grant from the Empire Development Fund a special laboratory has been established for the examination of essential oils and standards for the chief oils produced in the Colony have been laid down, whilst further developments are under consideration. The Imperial Institute has continued to give every possible assistance in connection with the development of the industry, and, amongst other matters, has investigated and reported on a further large number of oils distilled on an experimental scale by the Department. A selection of the reports made to the Government in the last year or two are printed below. They comprise reports on cinnamon bark oil, oils of *Ocimum* spp., palmarosa oil, and peppermint oil.

CINNAMON BARK OIL

Two samples of cinnamon bark oil were forwarded to the Imperial Institute by the Director of Agriculture in September 1936. They were as follows :—

A.—A cloudy golden-yellow oil, stated to have been distilled in July 1936 from bark collected in October 1934 from trees cropped two years previously. A yield equivalent to 4·5 litres per ton of bark had been obtained.

B.—A clear, golden-yellow oil. Definite particulars regarding the distillation of the bark employed were not available in the Department.

After filtration the oils were examined with the following results, to which are added for comparison the requirements of the British Pharmacopoeia for "oil of cinnamon" and figures recorded for oils distilled in Germany from Seychelles cinnamon bark :—

	Present Samples. A.	Present Samples. B.	British Pharmacopoeia figures.	Oils distilled in Germany from Seychelles bark.
Specific gravity at 15·5°/15·5° C. .	1·0142	1·0160	1·000 to 1·030	1·0058 to 1·0382
Optical rotation α_D	−2·01° at 20° C.	−1·74° at 20° C.	0° to −2°	−0·95° to −3·08°
Refractive index n_D20° C. .	1·5845	1·5812	1·565 to 1·582	1·57157 to 1·59347
Total aldehydes, as cinnamic aldehyde (by hydroxylamine method) *per cent.*	71·1	67·3	50 to 65	63 to 84
Solubility in 70 per cent. alcohol .	Insoluble in 10 vols.	Insoluble in 10 vols.	Soluble in 3 vols. with not more than slight opalescence.	Soluble in 2·5 to 3 vols., but many oils not entirely soluble.
Solubility in 80 per cent. alcohol .	Soluble in 0·7 vol.	Soluble in 0·8 vol.	—	—
British Pharmacopoeia test for absence of cinnamon leaf and cassia oils . .	Passed test	Passed test	—	—

The foregoing results show that the constants of the present oils agree with those recorded for the oils distilled in Germany from Seychelles cinnamon bark, but that neither conforms with the British Pharmacopoeia requirements for oil of cinnamon, both oils containing more aldehydes and being of lower solubility than is specified, whilst Sample A also showed a slightly higher refractive index.

The aroma and flavour of cinnamon bark oil are of prime importance from a market standpoint, and most users of the oil attach more value to a product which is satisfactory in these respects than to one which merely complies with the Pharmacopoeia specification for oil of cinnamon. A comparison between the present oils and a good sample of Ceylon cinnamon bark oil showed that neither of the Seychelles oils had as sweet and refined a flavour as the Ceylon product.

The oils were submitted to (*a*) a firm of essential oil distillers, and (*b*) and (*c*) two firms of importers in London, whose observations may be summarised as follows :—

(*a*) The essential oil distillers stated that the odour of both oils was coarse and "woody" and the flavour very inferior. They considered the high aldehyde content to be of little importance, as the odour and flavour of genuine cinnamon

oil is due mainly to constituents other than cinnamic aldehyde. The firm regarded the oils as of second or third rate quality, with a value not higher than 30*s.* per lb. (December 1936).

(*b*) One of the firms of importers stated that whilst the Seychelles oils were not comparable with the Ceylon product they represented an oil which could probably be marketed in London. The firm considered there to be very little difference between the two samples, and estimated their current value at 18*s.* to 20*s.* per lb. in the United Kingdom.

(*c*) The second firm of importers stated that the oils were at a disadvantage on the market by reason of their not complying with Pharmacopoeia requirements. The firm was favourably impressed with the odour of the present samples. It considered the current value of the oils to be about 28*s.* to 30*s.* per lb., but suggested that the Seychelles producers should be prepared to lower the price by a few shillings per lb. if the values of the compounded oils were to fall.

These two cinnamon bark oils were much superior to the samples from the Seychelles examined at the Imperial Institute in 1931 and previous years. These earlier oils contained only from 19 to 37 per cent. of aldehydes and were of very low quality.

The present samples contain a normal amount of aldehydes for cinnamon bark oil, viz. 71 and 67 per cent. The British Pharmacopoeia specification for "cinnamon oil" is 50 to 65 per cent. of aldehydes, but cinnamon bark oil obtained by straight steam distillation of the bark may contain up to 76 per cent. of this constituent. It would appear that the Pharmacopoeia standard is in conformity with the results of the methods employed by English firms.

Oils which do not conform to the British Pharmacopoeia standard are at some disadvantage on the United Kingdom market, but for some uses far more importance is attached to the aroma and flavour of the oil than to the actual percentage of aldehydes present.

It will be seen from the above commercial reports that trade opinions varied as to the quality of the aroma and flavour of the present samples in comparison with Ceylon

cinnamon bark oil, and consequently in the estimated value of the oils on this market. The actual value of the Seychelles oil will be known when the trade has received and worked consignments of the oil.

The value of the present samples, estimated at from 18*s.* to 30*s.* per lb., falls well below that of the best grades of Ceylon oil, which realise 3*s.* 6*d.* to 5*s.* per oz. The high quality of this Ceylon oil is due to the fact that it is obtained from a raw material superior to that employed in the Seychelles; in Ceylon the waste chips available from the preparation of quills, and young bark, are used. As regards the production in the Seychelles, it is highly probable that oil obtained from young bark would be found to be of better quality than that from older bark.

Ocimum basilicum (?) Oil

The two samples of Ocimum oil which are the subject of this report were forwarded to the Imperial Institute by the Director of Agriculture in March 1936. The oils had been distilled from a type of plant known locally as "Toc Maria." Samples of oils from this plant had been previously examined at the Imperial Institute (see this BULLETIN, 1934, **32,** 530), and herbarium specimens submitted by the Director of Agriculture in October 1934 had been identified at the Royal Botanic Gardens, Kew, as *Ocimum basilicum* L. ?

The samples were as follows:—

A. Distilled from leaves and flowers.—Time of distillation, 1 hr. 50 mins. Yield of oil equivalent to 4·8 litres per ton.

B. Distilled from whole plant (flowers, stems, and leaves).—Time of distillation, 1 hr. 40 mins. Yield of oil equivalent to 3·8 litres per ton.

Both samples consisted of clear, pale yellow, very mobile oils. They possessed a rather sweet taste and closely resembled each other in appearance and odour.

The oils were found to have the following constants, which are shown in comparison with the corresponding figures for the "Toc Maria" oils previously examined at the Imperial Institute and those recorded for commercial sweet basil oil:—

"TOC MARIA" (*OCIMUM BASILICUM?*) OIL

	Present samples.		Previous samples of "Toc Maria" oil from Seychelles.		Commercial Sweet Basil Oils.	
	A.	B.	June 1934.	September 1934.	Réunion.	French, German, Algerian and Spanish.
Specific gravity at 15·5°/15·5° C.	0·9646	0·9625	0·9746	0·9616	0·945 to 0·987	0·904 to 0·930
Optical rotation α_D	−0·38° at 22° C.	−0·49° at 24° C.	−0·4° at 19° C.	−0·64° at 24° C.	+0·36° to +12°	−6° to −22°
Refractive index $n_D 20°$ C.	1·5159	1·5159	1·5180	1·5160	1·512 to 1·518	1·481 to 1·495
Acid value	0·4	0·5	—	0·2	Up to 3	Up to 3·5
Ester value	5·9	4·1	—	6·3	9 to 22	1 to 15
Solubility in 80 per cent. alcohol at 15·5° C.	Soluble in 5·7 vols.	Soluble in 6·2 vols.	Soluble in 4·6 vols. with slight opalescence.	Soluble in 6·7 vols.	Soluble in 1 to 7 vols.	Soluble in 1 to 2 vols.

These results show that the characters of the present oils are similar to those obtained from the samples of " Toc Maria " oil previously examined. As in the case of the earlier samples, their constants more closely resemble those of Réunion sweet basil oil than those recorded for the French, German, Algerian, and Spanish products.

The odour and taste of the oils suggest the presence of some anethole, as well as methyl-chavicole (estragole), which is the principal constituent of the commercial sweet basil oils. No appreciable difference was observed between the odour of Sample A distilled from the leaves and flowers and that of Sample B distilled from the whole plant; it thus would seem that no advantage would be gained by separating and distilling only the leaves and flowers, since the increased yield of oil obtained by the separation would presumably not compensate for the cost of the extra labour required, although there might be some saving in fuel.

The oils were submitted to (*a*) merchants, (*b*) essential oil distillers, and (*c*) perfumery and soap manufacturers in London, which reported respectively as follows :—

(*a*) " We do not think that the difference between the two samples A and B is sufficiently marked to be of any real importance. We have in the past made efforts to sell a basil oil from Seychelles without success, and we are of opinion that the demand for this oil is so small as to make its production useless from a commercial point of view."

(*b*) " The French oil of basil is stated to be distilled from the same species of plant, but is very different in characters and odour from the oils under examination. Confusion seems to exist in the literature as to the precise plants from which the numerous basil oils noted are distilled. The above samples have a strong estragole note and could not replace the true French oil for perfumery or other uses. They resemble to a certain extent the Madagascar oil (the value of which is 26*s*. per lb, July 1936) as regards characters and odour."

(*c*) " Both the samples of this oil are good; the essences appear to have been prepared in a satisfactory manner. We think the perfume of Sample B is better than that of Sample A, and it would be advisable to concentrate on producing an

essence of the type of Sample B in preference to the type of Sample A.

" We find that the essence is of rather a different type from the essence of basil produced in France, and although we should not like to say that the French essence is superior, this difference will make it difficult to market the oil.

" The consumption of basil oil in the perfumery trade is, we believe, small, and is mostly confined to France. It would probably be advisable to keep the production on quite a small scale and endeavour to sell the oil on its own merits to perfumers in England, France, and to some of the big compound essence-producing firms in Switzerland."

The prospects of finding a satisfactory demand for this oil in the United Kingdom are not promising. The oil has not the fragrance of the French oil of basil, which is used in this country, though there is only a limited demand for it. It might be possible to dispose of the Seychelles oil in small lots from time to time, but it would seem inadvisable to encourage its production on a large scale.

Ocimum sanctum Oil

The four samples of oil dealt with in this report were forwarded by the Department of Agriculture in June 1936. They had been distilled from the plant being grown in the Department's trial grounds under the name " Ocimum No. 3." Herbarium material of the plant subsequently submitted has been identified at Kew as *Ocimum sanctum* L.

The samples were marked A, B, C, and D respectively and the following particulars relating to their distillation were furnished.

A. Oil distilled from soft stems and leaves. Distillation period 1¼ hrs.

B. First fraction of the oil which came over during the first half-hour of distillation.

C. Later fractions emerging half an hour after commencement of distillation and continuing for 45 minutes.

D. Oil distilled from the distillate.

The average yield of five distillations was equivalent to 6 litres of oil per ton of green material.

All four samples received consisted of yellow to pale

yellowish-brown oils, Sample C being the darkest in colour. They were examined with the following results, to which are added for comparison those obtained for the sample of Ocimum No. 3 oil from the Seychelles previously examined at the Imperial Institute (see this BULLETIN, 1934, **32**, 535).

	Present samples.				Previous samples from Seychelles.
	A.	B.	C.	D.	
Specific gravity at 15·5°/15·5° C.	0·9276	0·9172	0·9569	0·9833	0·9385
Optical rotation α_D	−12·25° at 20° C.	−10·85° at 21° C.	−15·20° at 22° C.	−10·05° at 22° C.	−9·93° at 24° C.
Refractive index $n_D 20°$ C.	1·4834	1·4778	1·4988	1·5054	1·4871
Acid value	3·3	2·5	6·1	2·5	6·5
Ester value	1·1	0·8	0·8	0·8	1·2
Ester value after acetylation	171·4	158·5	191·9	170·4	175·7
equivalent to "total acetylisable constituents" (expressed as $C_{10}H_{18}O$) *per cent.*	54·1	49·5	61·6	53·7	55·6
Phenols *per cent.*	22·8	16·5	—	—	—
Apparent cineole content of the phenol-free oil (by orthocresol method) *per cent.*	15·1	14·6	—	—	—
Solubility in 70 per cent. alcohol at 15·5° C.	Soluble in 1·7 vols.	Soluble in 1·9 vols.	Soluble in 1·6 vols.	Soluble in 1·6 vols.	Soluble in 1·8 vols.

NOTE.—*Samples C and D were insufficient for the determination of phenols and cineole.*

The foregoing results show that the present Sample A (the entire oil) has analytical constants generally similar to those of the previous sample of this oil. Sample B was stated to be the first fraction of a steam distillation, and this, as was to be expected, had a lower specific gravity and gave a lower figure for ester value after acetylation than Sample A, whilst Sample C, the later fraction of the distillation, had a higher specific gravity and a higher ester value after acetylation. Sample D, from the aqueous distillate, although showing approximately the same ester value after acetylation, had a considerably higher specific gravity.

The phenolic portion of the oil appeared to consist chiefly, if not entirely, of chavibetol. The unpurified phenolic portion readily congealed to a crystalline mass when immersed in a freezing mixture, and gave a benzoyl derivative which melted at 49°-50° C., the melting point of benzoyl chavibetol. With ferric chloride solution the phenol in alcoholic solution gave a deep bluish-green coloration similar to that given by chavibetol.

In odour, Sample A closely resembled the previous sample. The odour of Sample B was rather more fragrant than that of Sample A, whilst in the case of Sample C the odour of the oil as a whole appeared to be rather weak. The odour of Sample D was unsatisfactory and suggested that some decomposition had taken place during the distillation.

The following observations on the commercial value of the oil were furnished by the firm of essential oil distillers which was consulted in the case of the previous sample of this oil.

" Sample A is found to be superior to the sample examined in 1934. Sample B we find has a more lavender-like odour than A, C, or D. In our opinion if the proportions of C and D are small compared with A they should be excluded. The oil should be very suitable for blending with French lavender oil in compounding lavender perfumes for soaps and also for the less expensive toilet goods. It blends well with neroli and petitgrain.

" The presence of phenols in an essential oil is not a very serious drawback. Phenol-bearing oils are widely used in soap perfumery. The present oil should command a price at least equal to French spike lavender oil."

The oil was also submitted to a firm of soap-makers, which furnished the following report :—

" Our examination of this article shows that there are approximately 22 per cent. of phenols, which confirms our suspicion of the presence of this type of substance from the odour. Although this phenol content is not altogether detrimental, it does, however, restrict the possible use of this oil to coloured soaps, for if it was used in white soaps we are afraid discolorations would ultimately take place. We would assess this Ocimum oil at approximately *2s. 6d.* per lb. in comparison with the present spike lavender oil prices."

Judging from the examination of these samples it would seem unlikely that any advantage would be gained by distilling the oil in two fractions. It is certainly not advisable to market the oil in two qualities, and to discard fraction C is not recommended. With regard to Sample D, which, it is understood, represents oil recovered by the redistillation of the aqueous distillate, this is definitely an inferior oil. Presumably no oil thus obtained has been included in Sample A. Should

the properties of the present Sample D be typical of the oil recovered in this manner, its addition to the remainder of the oil distilled from this plant would probably lower the market value of the total oil, especially if it constitutes a significant proportion of the total oil. If the amount of oil thus recovered is comparatively small it would probably therefore be wiser not to collect it.

It would appear from the trade reports quoted above that the oil would find a market for soap perfumery, but the trade opinions differ as to the price the oil is likely to realise. One firm is of the opinion that its value would be equal to that of French spike lavender oil, which it resembles in odour, while another firm assesses the value at 2*s*. 6*d*. per lb. Spanish spike lavender oil was recently quoted at 3*s*. 6*d*. to 4*s*. per lb., spot, in London, and the French oil at 6*s*. 6*d*. per lb. (November 1936).

Palmarosa Oil

Samples of palmarosa oil have been examined on two occasions recently, and the reports on their examination are dealt with separately below.

Report No. 1

The sample which is the subject of this report was forwarded to the Imperial Institute by the Director of Agriculture in December 1935.

The oil was stated to represent a strain of plants now being widely propagated in Seychelles, which had furnished three samples previously examined at the Imperial Institute, viz., a sample (A) submitted in 1931 (see this Bulletin, 1934, **32**, 518), and two samples (B and C) submitted in 1933 (*ibid.*, p. 519). In forwarding the latter samples the Director of Agriculture stated that they had been experimentally distilled from plants of a variety of which 3,000 had been raised vegetatively from six plants isolated by Mr. Holdsworth Haines.

The oil consisted of a clear pale yellow oil. It was examined with the following results, to which are added for comparison the corresponding figures obtained for the previous samples

A, B, and C examined at the Imperial Institute, and the range of corresponding figures recorded for Indian palmarosa oils.

	Present Sample.	Previous samples from same type of plant. A.	B.	C.	Recorded figures for Indian palmarosa oils.
Specific gravity at $15 \cdot 5°/15 \cdot 5°$ C. . . .	0·9015	0·9083	0·8960	0·8968	0·887 to 0·900
Optical rotation a_D .	$-0 \cdot 25°$ at 18° C.	$+3 \cdot 1°$ at 20° C.	$+0 \cdot 03°$ at 24° C.	$-0 \cdot 22°$ at 18° C.	$+6°$ to $-3°$
Refractive index $n_D 20°$ C.	1·4738	1·4796	1·4715	1·4722	1·472 to 1·477
Acid value . .	4·0	1·4	1·2	1·0	0·5 to 3·0
Ester value . .	17·7	46·1	97·2	90·3	12 to 45
Ester value after acetylation . . .	267·9	262·3	276·1	273·5	226 to 274
equivalent to "total geraniol" *per cent.*	92·1	89·8	95·8	94·6	74·8 to 94·8
Solubility in 70 per cent. alcohol at 15·5° C. .	Soluble in 1·6 vols.	Soluble in 1·6 vols.	Soluble in 1·8 vols.	Soluble in 1·6 vols.	Soluble in 1·5 to 3·0 vols.

The present sample, like the previous samples referred to as A, B, and C, possessed a rather high specific gravity. The ester value, however, was considerably lower, and in view of the abnormally high acid value of the present oil, it would appear that a partial hydrolysis of the esters had taken place. The aroma of the oil was, however, satisfactory, and the oil contained, as in the case of the previous samples, an excellent percentage of total alcohols.

Report No. 2

This report covers two samples of palmarosa oil forwarded to the Imperial Institute by the Director of Agriculture in October 1936. The oils were stated to have been distilled from plants raised from Indian seed, and were submitted for investigation in continuation of the investigation of a sample of similar origin examined in 1935 (this BULLETIN, 1935, **33**, 140).

The samples (A and B) consisted of yellow oil; Sample A, described as "over one year old," was slightly darker in tint than Sample B (which was "freshly distilled") and contained a very slight white deposit: it was therefore filtered before examination.

The oils were examined with the following results, which are shown in comparison with those obtained for the sample investigated in 1935 and with the ranges of corresponding figures recorded for Indian palmarosa oils:—

	Present samples. A.	Present samples. B.	Sample examined in 1935.	Recorded figures for Indian palmarosa oils.
Specific gravity at 15·5°/15·5° C.	0·9128	0·8949	0·8886	0·887 to 0·900
Optical rotation α_D	+0·36° at 19° C.	+0·35° at 20° C.	+0·41° at 20° C.	+6° to −3°
Refractive index $n_D 20°$ C.	1·4770	1·4743	1·4736	1·472 to 1·477
Acid value	8·0	2·2	1·4	0·5 to 3·0
Ester value	57·7	49·8	29·2	12 to 45
Ester value after acetylation	273·7	275·7	272	226 to 274
equivalent to "total geraniol" *per cent.*	94·7	95·5	94·0	74·8 to 94·8
Solubility in 70 per cent. alcohol at 15·5° C.	Soluble in 1·5 vols.	Soluble in 1·6 vols.	Soluble in 1·6 vols.	Soluble in 1·5 to 3·0 vols.

These results show that the present samples, like that examined in 1935, contained a very high percentage of "total geraniol." Unlike the earlier sample from Seychelles, however, the present oils had very high ester values, the figures for this constant being outside the range recorded for the Indian product. Furthermore, Sample A had an abnormally high specific gravity and acid value, possibly attributable to storage under unsuitable conditions.

The odour of the present oils closely resembled that of the sample examined in 1935.

The oils were submitted to a firm of essential oil distillers in London, which reported on them as follows:—

"The specific gravities and refractive indices are higher than those of the sample examined in June 1935. This increase is probably due to higher ester value. The odour of Sample B is very similar to that of the last sample, but somewhat finer. Sample A is very good but rather citral-like. This is probably caused by oxidation during storage in uncorked vessels. As we reported last year, this oil is certainly superior to Indian distilled oil."

At the time of this report Indian palmarosa oil was quoted in London at 5*s*. 10½*d*.-6*s*. per lb. (December 1936).

The examination showed that the present oils are very similar in quality to the oil distilled from plants raised from Indian seed previously examined, and that the superior quality of the oil has been fully maintained.

Peppermint Oil

The sample of oil which is the subject of this report was forwarded to the Imperial Institute by the Director of Agriculture in December 1936. Herbarium specimens of the plant

from which the oil had been distilled have been identified at Kew as *Mentha arvensis* L., the source of Japanese peppermint oil. The time of distillation of the oil was stated to be under 1 hour, the yield of oil being equivalent to 9·3 litres per ton of fresh material.

The sample consisted of clear almost colourless oil, from which at ordinary temperatures solid menthol separated out in the form of crystals.

The oil was found to have the following constants, which are shown in comparison with figures recorded for natural Japanese peppermint oil derived from *Mentha arvensis* :—

	Present Sample.	Japanese Peppermint Oil.
Specific gravity at 15·5°/15·5° C.	0·9009	0·900 to 0·912
Optical rotation α_D . .	−36°C. at 21° C.	−26° to −42°
Refractive index $n_D 20°$ C. .	1·4603	1·4600 to 1·4635
Acid value	0·1	0·5 to 2·5
Ester value	14·2	—
equivalent to menthyl acetate . . *per cent.*	5·0	3 to 8
Ester value after acetylation .	240·0	—
equivalent to "total menthol" . *per cent.*	81·5	70 to 90
Solubility in 70 per cent. alcohol at 15·5°	Soluble in 2·9 vols.	—
Solidifying point . . .	17·5° C.	16° to 28° C.

These results show that the present oil has the characters of natural Japanese peppermint oil derived from *M. arvensis*, and like this product it contains a high percentage of menthol.

The ordinary Japanese peppermint oil which comes on the market is not the natural product, but the so-called "dementholised" oil, representing natural oil from which 45 per cent. of solid menthol has been separated by cooling by means of a freezing mixture. This "dementholised" oil (or commercial Japanese peppermint oil) still contains from about 40 to 54 per cent. of "total menthol." The separated menthol is exported as such.

There was not sufficient of the present oil available to determine the proportion of solid menthol which could be separated by freezing.

The sample was submitted to a firm of essential oil distillers in London, which furnished the following observations :—

"This oil, in possessing a high menthol content, resembles the Japanese undementholised oil. We have tested it also for flavour and find it to compare satisfactorily with Japanese

qualities. Japanese undementholised oil does not come freely on to the English market and there is a limited demand for it, the usual commercial quality being dementholised. The price of the former might be about 9*s*. to 10*s*. per lb. and the latter 5*s*. per lb.

" Provided the oil can be produced cheaply we do not see why it should not have a commercial future."

The results of this investigation show that the present oil would find a market in competition with Japanese peppermint oil, which it closely resembles, and is of similar quality. As mentioned, the oil usually exported from Japan has been freed from the solid menthol, which has been separated from the cooled oil. The crystalline menthol thus extracted is exported separately and is currently quoted in London at 13*s*. per lb. spot, duty paid (March 1937).

As mentioned by the essential oil distillers whose observations are quoted above there is only a limited demand for the natural Japanese oil on this market, and it has been suggested to the Department of Agriculture that it would be worth while to consider the dementholising of the present oil in the Seychelles should its production in commercial quantities be undertaken. The bulk of the menthol is removed by subjecting the oil to a low temperature by means of ice and salt mixtures, the menthol being then filtered off and marketed separately. The so-called dementholised peppermint oil thus produced would find a readier market than the natural oil. On the other hand it was pointed out that if such processing is not easily practicable in the Seychelles, the market might be tested in the first place with a small consignment of natural oil.

It may be observed that the yield of oil from the plants distilled in Seychelles is rather lower than that reported to be obtained in Japan, which is from 1 to 1·6 per cent.

LALANG GRASS (*IMPERATA ARUNDINACEA*) AS A PAPER-MAKING MATERIAL

LALANG grass (*Imperata arundinacea* Cyr.) is a very troublesome weed in many parts of the Eastern Tropics, especially in Malaya and Ceylon, and occurs abundantly also in the

island of New Guinea, in South Queensland, parts of India, Indo-China, etc. In view of its great abundance in many places, often to the exclusion of other plants, the grass has frequently been suggested as a source of pulp for paper-making, and the tests that have been carried out have indicated that it is a very promising material for this purpose, comparable with Algerian esparto. The long distances over which the grass would have to be brought would preclude its use as a substitute for esparto in English mills, and it would be necessary to convert it into pulp close to its source.

One of the earliest attempts to utilise *Imperata arundinacea* was in 1891, when a concession for working the grass in Johore was granted by the Sultan. Analyses of the material were made in London by Cross and Bevan, who reported that the value of the material was "equal to the highest qualities of the esparto grass" (*Agric. Bull., S.S. and F.M.S.*, 1907, **6**, 379-380). The Aynsome Technical Laboratories examined a sample from Singapore and stated that paper suitable for printing could be made from it (*ibid.*, 1908, **7**, 585-587), whilst Messrs. John Dickinson & Co., Ltd., reporting on a sample of half-stuff prepared from the grass in Singapore, said that "as a paper-making material it seems to occupy an intermediate position between Spanish esparto and good straw fibre" (*Kew Bull.*, 1909, 55-59). A sample of the grass from the Federated Malay States was examined at the Imperial Institute in 1917 (this BULLETIN, 1918, **16**, 271-273). The results showed that lalang grass gives a good yield of pulp which has excellent felting qualities and produces a strong opaque paper which does not shrink on drying. In yield of pulp and character of the fibres the Malayan lalang compared favourably with Algerian esparto, but it required slightly more drastic treatment than the latter if the pulp is to be bleached and used for the manufacture of white paper. In spite of all these favourable reports no commercial developments appear to have taken place in Malaya.

Imperata arundinacea was examined by Raitt in the course of his researches on the Savannah Grasses of Northern and Central India (*Ind. For. Rec.*, 1913, **5**, 93). In this case, however, he found that although the Indian grass gave a good yield of pulp, the latter proved weak and difficult to bleach.

An Italian worker, Ferdinando Vignolo-Lutati (*Ann. Acad. Agric. Torino*, 1915, **58**, 68-76), has reported that the cellulose of *Imperata cylindrica* (= *I. arundinacea*) grown in Italy is very similar to that of esparto, and that no greater consumption of chemicals is required to produce paper-pulp from it than from esparto.

In Queensland *I. arundinacea* has been used commercially for the production of paper pulp, and in 1919 the Queensland Pine Co. were stated to be producing 10 tons of pulp weekly (*Can. Weekly Bull. Tr. Comm.*, 1919, **21**, 975). The grass has also been stated to be employed for the manufacture of paper in Indo-China (*Bull. Agric. Inst. Sci. Saigon*, 1919, **1**, 188).

The most recent development in the commercial utilisation of the grass was the formation in 1936 of an Australian company with a nominal capital of £3,000,000 to erect pulp mills and manufacture paper pulp from *I. arundinacea* in Papua and New Guinea and to manufacture fine writing and printing papers in Australia. The grass is known in Papua as "kuru-kuru" and in New Guinea as "kunai." According to a report in the local press the Company have secured the lands required from the Administration of Papua, including 45,000 acres at Collingwood Bay, in the north-eastern division, where the first unit of plant with an output of 20,000 tons of bleached pulp per annum is to be erected. The lands secured are sufficient, it is claimed, for the establishment of three such units. It is stated that extensive areas in the Mandated Territory of New Guinea have also been surveyed.

A sample of the grass from Papua was examined at the Imperial Institute in 1918 (this BULLETIN, 1919, **17**, 155-157). The results, both in respect of yield and quality of the pulp, were not quite as good as those which were obtained with the Malayan grass referred to previously, but this is possibly to be attributed to the sample being in rather poor condition when received.

As already mentioned, *Imperata arundinacea* is common in Ceylon, and with a view to ascertaining the suitability of the grass occurring there as a source of paper pulp, a sample, under the name of "Illuk" grass, was forwarded to the Imperial Institute by the Registrar-General and Director of

Commercial Intelligence in September 1936. The report on the material is given below.

Illuk Grass from Ceylon

The sample received consisted of bundles of dried grass about 4 ft. long, varying in colour from cream to pale brown. In nearly all cases the bundles consisted of the leaves of the plant cut above the level of the junction with the leaf-sheaths, but occasionally the leaf-sheaths were present. The lamina of the leaf, about $\frac{1}{2}$ in. across at its broadest point, commonly extended for about half the length of the leaf (in its upper part) as cut, and gradually tapered to the stout, stiff midrib which had the appearance of a leaf-stalk. The stalk-like midribs were more or less cylindrical and about $\frac{1}{32}$ in. in diameter.

A representative portion of the sample was chemically examined with the following results:—

	Per cent.
Moisture	8·8
Ash	6·1
Cellulose, in material as received	42·1
Cellulose, expressed on the moisture-free material	46·2

The dimensions of the ultimate fibres were found to be as follows:—

	Length. *mms.*	Breadth. *mms.*
Maximum	3·0	0·0155
Minimum	0·2	0·0047
Average	0·9	0·0074
Mostly	0·5 to 1·5	0·006 to 0·009

The ratio, average length/average breadth was 122 : 1.

The ultimate fibres resembled those of esparto in being fine fibres with tapering ends; the lumens were exceedingly fine, and often indistinguishable. A few broader more ribbon-like fibres were present.

Pulping Trials.—The grass, after cutting in a chaff-cutter, was digested with caustic soda under conditions approximating to those employed commercially for the production of pulp by the soda process. The conditions employed and the yields obtained are given in the following table:—

	Trial A.	Trial B.
Parts of caustic soda used per 100 parts of :		
Grass	16	16
Solution	3	3
Conditions of digestion :		
Time . . . . . . *hours*	4	3
Temperature . . . . . ° *C.*	140	140
Parts of caustic soda consumed per 100 parts of grass	9·5	9·4
Yield of moisture-free pulp :		
Calculated on grass as received.		
Unbleached . . . *per cent.*	39·8	42·0
Bleached . . . *per cent.*	32·9	38·4
Calculated on moisture-free grass.		
Unbleached . . . *per cent.*	43·6	46·1
Bleached . . . *per cent.*	36·1	42·1

Trial A.—Under these comparatively mild conditions a well-boiled pulp was obtained which furnished an opaque, well-closed sheet, of greyish-cream colour and possessing satisfactory strength. No shrinkage of the sheets occurred on air-drying. The pulp bleached very easily to a good white colour and furnished paper similar in other respects to the unbleached paper.

Trial B.—Since Trial A had resulted in a well-boiled pulp, a second digestion was carried out to ascertain whether satisfactory results could be obtained under even milder conditions of treatment. The time of digestion was accordingly reduced to 3 hrs. whilst other conditions remained unaltered. These conditions of digestion proved just sufficient to produce a well-boiled pulp, and an increased yield of about 2 per cent. of unbleached pulp was obtained. The pulp, moreover, bleached readily and gave bleached and unbleached papers similar in character to those obtained in Trial A.

The results of this investigation of Illuk grass show that it furnishes a fairly good yield of pulp by the caustic soda process from which paper of satisfactory quality can be made. It requires only a mild treatment of normal character.

In the form of the present sample the grass has the advantage of being free from roots and adherent impurities, such as are normally liable to contaminate commercial esparto and straw respectively.

The yield of bleached pulp from the sample was somewhat lower than that obtained under comparable conditions at the Imperial Institute from Algerian esparto (42·1 per cent. as

compared with 46·6). In character the ultimate fibres somewhat resemble those of esparto, but the paper produced from the pulp in this experiment differed from esparto paper in being harder and less bulky. The bleached pulp, either alone or in admixture with other materials, would be suitable for the manufacture of writing, book and printing papers.

TURTLE OILS FROM CEYLON

TURTLE oil has recently come into prominence as a constituent of cosmetics, and small supplies are entering commerce from various parts of both the Old and the New Worlds. Four samples of the crude oil prepared experimentally in Ceylon were forwarded to the Imperial Institute by the Trade Commissioner in London in December 1936, and the results of their examination are given below.

The samples were as follows :—

1. " *Carapace Oil of Leathery Turtle* : *rendered over fire in a zinc bath-tub.*"—A reddish-brown liquid, containing a large quantity of light brown stearines and possessing a strong fishy odour. When melted the oil was clear and very dark reddish-brown.

2. " *Dhara kasbava Oil* : *Dermochelys coriacea.*"—A golden-brown liquid, containing a very large quantity of yellowish-brown stearines and possessing a very unpleasant, strong, fishy and rancid odour. When melted the oil was clear.

3. " *Green Turtle* : *Perr Amai Oil* : *Chelonia mydas.*"—A golden-brown liquid, containing a large quantity of yellowish stearines and possessing a fishy odour. A very small amount of " dirt " (albuminoid matter) was present. When melted the oil was very slightly cloudy.

4. " *Kanga mattaya Oil* : *Lepidochelys olivacea.*"—An orange semi-solid oil with a fishy odour. When melted the oil was very slightly cloudy.

The oils were examined with the following results, to which are added, for comparison, corresponding figures recorded for turtle oils, including those for a sample of turtle oil from Ceylon referred to in the report of the Trade Commissioner for Ceylon in London, 1936 (p. 51).

	Present samples.				Recorded figures.						
						Green Turtle (*Chelonia mydas*).		" Turtle."			
	Leathery Turtle : Carapace Oil.	Dhara kasbava (*Dermochelys coriacea*).	Green Turtle (*Chelonia mydas*).	Kanga mattaya (*Lepidochelys olivacea*).	Leathery Turtle (*Dermochelys Schlegelii*) Japan.	(1).	(2) Panama.	West African.	Eleven Commercial Samples.	Ceylon.	Egyptian
Moisture *per cent.*	0·1	0·2	0·1	0·2	—	—	—	—	—	—	—
Specific gravity at 100/15° C.	0·8696	0·8671	0·8644	0·8710	0·9252 at 15/4° C.	0·9335 at 15/15° C.	0·9205 at 15/15° C.	0·9112 at 40/40° C.	0·914 to 0·919 at 25° C.	—	—
Refractive index at 40° C.	1·4650	1·4635	1·4591	1·4698	1·4753 at 20° C.	1·4769 at 20° C.	—	1·4599	1·4658 to 1·4715 at 20° C.	1·459	1·4585
Acid value	1·6	17·1	1·1	0·4	2·0	1·17	0·56	2·0	—	1·45	—
Saponification value	197·5	199·6	207·6	191·5	181·3	193·8	213·5	209	197-210	209·5	213
Iodine value *per cent.*	98·9*	103·8*	68·2*	148·7**	128·1	127·4	61·5	64·6	89-97	65·5	57·2
Unsaponifiable matter *per cent.*	3·3	1·8	0·5	1·3	—	—	0·45	0·6	—	0·65	

* Wijs, ½ hr. ** Wijs, 1 hr

The foregoing results show that three of the samples had satisfactorily low acid values, but that of the oil of *Dermochelys coriacea* (Dhara kasbava) was somewhat high. This high acidity is probably due to the oil not having been prepared from fresh material or to deterioration resulting from storage under unsuitable conditions. No standard figures are available for the constants of the limited quantities of turtle oil imported into the United Kingdom, but, so far as can be judged from the results of the examination, the present samples show no indication of any abnormality.

Of the four samples in the present series the oil from the green turtle gives analytical figures closely resembling those for the Ceylon turtle oil quoted for comparison, and it would appear most probable that the latter oil was derived from this species of turtle. The constants of the present sample of green turtle oil agree fairly satisfactorily with those recorded for this oil from Panama, but they differ from the other set of figures quoted in the table for oil of this species.

According to the *Ceylon Journal of Science*, 1930, Section B, Vol. VI, Pt. 1, p. 45, the leathery turtle is *Dermochelys coriacea* and is known locally as "Dhara kasbava." The present samples labelled "Carapace Oil of Leathery Turtle" and "Dhara kasbava" were therefore presumably derived from the same species. A comparison of the results obtained for these two samples shows that they are very similar, the main differences being in respect of acid value and percentage of unsaponifiable matter. It will be seen that the saponification and iodine values of these two oils differ from those recorded for the Japanese product, which is stated to be derived from another species of *Dermochelys*, viz., *D. Schlegelii*.

ARTICLES

THE CULTIVATION OF PYRETHRUM IN JAPAN

THROUGH the courtesy of the Department of Overseas Trade the Imperial Institute was furnished a few years ago with a valuable report on the pyrethrum industry of Japan, which had been prepared by the British Vice-Consul at Seoul, Japan. It covered every aspect of the subject, including the

methods of growing and preparing the flowers, details of the production and trade, and a discussion of the economics of the industry. The report was published in this BULLETIN, 1930, **28**, 300-342, but owing to the great interest the report aroused the number went out of print. In view of the attention that is being given to the cultivation of pyrethrum in many parts of the Empire and the requests that are received from time to time at the Imperial Institute for information as to the methods practised in Japan, which is still by far the largest producer of the flowers, it has been thought desirable to reprint in the present issue those portions of the original report which are likely to be of most concern to the planter. The figures in the introductory section have been brought up to date from reports received periodically from the Department of Overseas Trade.

INTRODUCTORY

So far as Japan is concerned Pyrethrum (Japanese: Jochugiku or Mushiyokegiku) is a product of recent years. Although there is some doubt regarding its earliest origins, it appears to have been known in Persia for its insecticidal properties several centuries ago. It was introduced into Europe early in the nineteenth century, when both the plant itself and powder ground from the flowers were imported from the Persian fields and markets to meet a widespread demand for an effective vermin killer. Some forty or fifty years later, during the period 1850-1860, another species of the plant was introduced from Dalmatia which proved more effective as an insecticide than the Persian species, and rapidly superseded it in the pyrethrum fields of Europe.

It was not until 1881, however, that pyrethrum was introduced into Japan, cultivation being first undertaken experimentally four years later with the Dalmatian species in Wakayama Prefecture, and with plants from American seeds sown at the farm of the Komaba Agricultural School in Tokyo. The success of these experiments suggested the commercial possibilities of the flower, and serious cultivation began in 1886.

Cultivation spread gradually, and in 1896 the plant found its way to Hokkaido, the northern island of Japan, in the form of twenty-five seedlings, brought from a Tokyo nursery

by Seiichiro Keneko, a native of Niigata. Settling in the Ishikari district of Hokkaido, this enterprising farmer planted his handful of seedlings, and, finding the soil and climate favourable, began in 1902 to extend cultivation on an ambitious scale.

Since that date the area of land in Hokkaido and other Prefectures given over to the cultivation of pyrethrum has steadily increased until to-day probably three-quarters of the world's yield is claimed by Japan.

Striking evidence of this increase is afforded by comparison of the yields for 1912 and 1926. During the fourteen years 1912-1926 the area under cultivation in Hokkaido spread from approximately 31 acres to 25,600 acres and the yield from 14,000 lb. to 10,071,100 lb. During the next ten years the growth was on much the same scale, the total area in 1936 reaching 71,880 acres and the yield 25,000,000 lb. In 1937, however, the estimated area and yield showed a decline. The detailed figures for the different Prefectures are given in the following table:—

	1935.		1936.		1937.	
	Area.	Yield.	Area.	Yield.	Area.	Yield.
	acres.	*tons.*	*acres.*	*tons.*	*acres.*	*tons.*
Wakayama	3,464	1,390	4,040	1,240	3,460	1,107
Okayama	3,084	1,060	2,930	870	2,500	812
Hiroshima	5,000	2,093	5,220	1,720	5,000	1,925
Yamaguchi	700	273	1,000	320	1,000	370
Ehime	4,470	1,618	4,140	1,240	4,140	1,110
Kagawa	2,928	1,164	2,800	857	2,060	738
Hokkaido	46,550	5,155	51,750	4,880	42,000	3,850
Total	66,196	12,753	71,880	11,127	60,160	9,912

Description of the Plant

While for the sake of convenience the trade name of Pyrethrum has been used throughout this report to designate the plant, which is a perennial of the Compositæ family, the most generally accepted botanical name of the Dalmatian species appears to be *Chrysanthemum cinerariæfolium* Vis. (syn. *Pyrethrum cinerariæfolium* Trev.).

In general appearance not unlike an English wild camomile, this is the only species of the plant bearing white flowers.

The flowers of the other species, of which the Persian, Armenian, Hungarian, and Indian are the chief, are coloured rose-pink or red.

Among the red-flowered plants the commonest are those

of the Persian species, known to botanists as *Chrysanthemum coccineum* Willd. (syn. *Chrysanthemum roseum* Web. and Mohr, or *Pyrethrum roseum* Bieb.).

Apart from the colour of the ray-florets, the main superficial distinction of the Dalmatian species is the darker colour of the leaves and the presence of fine hairs on their lower surface.

Advantages and Disadvantages of the Dalmatian (white) species

The Dalmatian species (1) is an abundant seed producer with a good rate of propagation; (2) bears a large number of heads on each plant and accordingly yields large crops; (3) has large roots which are quick and sturdy growers; (4) is more delicate as regards resistance to disease and injury; (5) flowers too late to be used against early vermin; (6) bears small florets.

Advantages and Disadvantages of the Persian (red) species

The Persian species (1) flowers early and thus yields early crops; (2) bears large florets which are convenient for industrial purposes; (3) has few heads on each plant and accordingly yields small crop; (4) produces few seeds and shoots, the rate of propagation being accordingly poor; (5) retains poor colour in the manufactured powder and consequently commands only a low market price.

A comparison of the qualities of the red and white species reveals that the white is the more prolific seed and crop producer and retains a finer colour in the manufactured product. Its insecticidal action is also quicker. For these reasons the white-flowered plant has the monopoly of insecticide-plant cultivation in Hokkaido, the red-flowered plant being grown solely in gardens for decoration.

PYRETHRUM MANUFACTURES IN HOKKAIDO

Owing to the traditional position of the Kobe district as the centre of the industrial and commercial side of the pyrethrum trade, Hokkaido has been slow to develop the manufacture of pyrethrum powders and sprays, and the bulk of the pyrethrum crop leaves Hokkaido in the form of dried flowers.

An industrial concern, however, has been established at Kutchan under the name of the Hokushin Yakuso Kabushiki Kaisha.

What might be termed the three basic products are: (1) flower powders, (2) leaf and stalk powders, and (3) liquid extract mixtures.

(1) Into the first category fall those articles known to the trade as "Fly-powder," "Satchufun" (Insect-powder), and "Nankinsan" (Bug-powder).

These are no more than the dried flowers artificially desiccated and ground to powder by successive grinding machines until the required degrees of fineness are obtained, the powder being finally sorted by machine into different qualities according to the degree of fineness and packed for the market.

The powders are used for the extermination of flies, of noxious insects found on fruit-trees, vegetables, cattle and poultry, and also of bugs and fleas.

(2) Since powder ground from the stalks of pyrethrum has been found to possess insecticidal properties in certain forms and against certain insects, the Hokushin Yakuso Kabushiki Kaisha have devoted a large part of their activities to the manufacture of this powder.

The dried stalks and leaves are chopped by machines, artificially desiccated, pulverised in the grinding machines, and finally machine-sorted.

The powder thus obtained is either made into mosquito sticks for use in houses and poultry-runs, or mixed with the powder obtained from the dried flowers to form an insecticide for use as a grub-killer. The latter is widely used throughout Japan by local sanitary associations.

(3) The third basic product of the industry is Pyrethrum Extract, which is obtained by the following process.

Pyrethrum powder ground from the dried flowers is wrapped in a cloth and placed in a tin filled with volatile oil. While being soaked, the bag should be shaken from time to time in the oil until two or three days have elapsed, when the bag is removed from the oil and the liquid drained from the bag. This process is repeated in a second tin of volatile oil, and the liquid thus obtained mixed with that obtained from the previous extraction.

By subsequent distillation the volatile oil is removed and

the effective constituent is left. This is added to alcohol and water and thoroughly shaken into a creamy emulsion.

This extract in different degrees of dilution is sold for the extermination of bird-lice and vermin.

From the three basic products described above are obtained a number of derivative products, of which a brief description follows.

Pyrethrum Carbon mixtures: A mixture of pyrethrum and carbon has been found particularly effective as a destroyer of the larvæ of the common white (cabbage) butterfly. It is prepared by mixing 1 part of the powdered pyrethrum flowers with 40 parts of charcoal, and is ready for use after it has been stored for two days in a sealed jar.

Pyrethrum Lixivium: This is obtained by distilling a mixture of pyrethrum powder and water in the proportion of ⅛ oz. to ¼ oz. powder to 3 pints of water. It is used chiefly to exterminate the larvæ of butterflies and moths.

Pyrethrum Petroleum Emulsion: A mixture of pyrethrum powder and petroleum in the proportion of 2½ oz. of powder to 3 pints of petroleum is kept stoppered for at least two days, after which an emulsion is prepared by filtration in the same manner as petroleum emulsion is obtained. Pyrethrum Petroleum Emulsion is chiefly used for the protection of crops against blight.

Pyrethrum Lixivium Petroleum: This is a more active exterminator of dust and dirt carriers than plain petroleum and takes the form of a solution made from pyrethrum powder and petroleum in the proportion of 2 oz. of powder to 3 pints of petroleum, the solution being firmly stoppered for at least two days and subsequently strained through a cloth.

Tincture of Pyrethrum: Tincture of pyrethrum is obtained by macerating pyrethrum powder with alcohol (in the proportion of about 1 oz. of powder to 1 lb. of alcohol) in a stoppered container for at least one week, and filtering the product. This insecticide is used mainly to exterminate the insects which attack cherry, peach, and mulberry trees, and to eradicate lice and fleas from the hair of cattle and horses.

Pyrethrum Powder: The powder produced in Japan under this trade name is a mixture of one part of ordinary pyrethrum powder and 3 to 5 parts of powder of lime or starch, the mixture having been kept firmly stoppered for the space of one day

before being ready for use. As an insecticidal agent it is effective against the same insects as ordinary insect powder.

Mosquito Sticks: These joss-sticks are made by mixing carefully selected pyrethrum powder with a small quantity of pyrethrum stalk powder, stiffening the mixture with the glutinous powder of cinnamon leaves, the latter being in the proportion of about 1½ to 2 per cent. of the former. As the name implies, these sticks are used for smoking out mosquitoes.

Climate and Soil Requirements

Pyrethrum thrives best in a comparatively dry climate and well-drained sandy soil. In fact, provided that the climate and soil are not damp, the plant will grow even on mountainous or waste land. When it is planted on sloping ground, however, a larger quantity of manure is required than on level ground, the manure in the former case being constantly washed down the slope.

In Persia and Dalmatia (Yugoslavia) the plant is usually cultivated on dry land at a high altitude, the Persian species in particular flourishing as high as six or seven thousand feet above sea level. In Okayama, Hiroshima, and Wakayama, the chief producing centres in the main island of Japan, the climate is comparatively dry and warm, and cultivation nowadays covers even the hillsides where the soil is of the right texture.

Hokkaido, though colder than the producing centres in the main island, enjoys the advantage of heavy snows in winter. Under their winter-long covering of snow the roots are protected from the cold, whereas in the main island the winters, though seldom bringing heavy falls of snow, are sufficiently cold to freeze the surface of the land and thereby injure the roots of the plants.

Although the rainfall in the producing centres of Hokkaido is small during the period from growth of the flower to harvest, no actual drought is suffered on account of the atmospheric temperature which prevails in those parts.

Cultivation

(1) *Sowing.*—For seed-beds, land is chosen which is exposed to the sun and has soft, sandy soil and good drainage; this is ploughed deeply, the lumps of earth are well crushed and

flat ridges are raised of a width of 3 ft. Well-chopped stable litter is applied as manure and night-soil and superphosphate of lime are added. Excessive application of manure promotes too rapid a growth, and care must therefore be taken to apply it in moderation. After the lapse of a week the land is ploughed again so as to mix the earth and manure, and pebbles and clods of earth are eliminated by sifting with a riddle having a half-inch mesh. The ground is then levelled and flattened with gentle and even pressure, by means of a wooden board or plate, so as to ensure even growth of shoots, and the seeds are sown in the proportion of about 2 pts. of seed to 300 sq. yds. of ground. Seedlings from a given area of seed-bed cover on the average after transplantation an area ten times as large.

There are two sowing seasons, one in spring and the other in autumn. Spring sowing is carried out in the middle of May, and autumn sowing towards the end of September. For spring sowing, seeds collected in the previous year are used, the seeds used for the autumn sowing being those collected during the current year. Old seeds should be avoided on account of their poor germination. The sowing season in Hokkaido is the spring.

Before being sown the seeds are placed in tubs of water and thoroughly soaked; they are then wrapped in cloth or sacking and buried in damp sand for four or five days, after which they are mixed with dry sand and sown evenly and in small quantities. Even sowing is usually ensured by the use of an empty tin can in the bottom of which holes have been drilled. Earth should then be sprinkled over the seeds by means of a riddle having a third of an inch mesh until the seeds are no longer visible. In order to protect them from becoming parched by the direct rays of the sun, the beds should be shaded with straw matting. They should also be protected from wind and drought by being fenced round with reed screens, which should only be removed at night or in cloudy weather. During prolonged spells of heat the beds should be watered regularly after sunset. A careful watch should be kept for weeds, which check growth or even destroy the shoots. If these directions are followed the shoots will appear in most cases in twelve or thirteen days. The straw shades may then be carefully removed, preferably on a cloudy day.

To promote vigorous growth, the seedlings, when grown to a height of 2 or 3 in., should be treated with fertiliser, the most suitable for the purpose being night-soil diluted with water in the proportion of 1 part of night-soil to 3 parts of water. By the end of September seedlings from the spring sowing may be expected to reach a height of 3 or 4, or, in good conditions, even 5 in.

(2) *Transplantation.*—When the shoots have reached this stage, which if they are spring sown falls between the middle of September and the beginning of October, transplantation must be taken in hand. It is important that the right season be chosen, for if they are transplanted too early the flowers are poor, while if they are transplanted too late the cold will kill them before their roots have taken a firm hold.

As pyrethrum is a perennial and can be cultivated for several years, nothing can be done to the soil after the shoots have been planted. This must, therefore, be well prepared beforehand, the ground being ploughed, all weeds removed by the root, and the surface carefully levelled. When the farm has been suitably prepared, seedlings are planted in lines at intervals of from 7 in. to 1 ft. between the plants and 1 ft. to 2 ft. between the lines. To prevent stagnant rain-water from gathering round the roots and thereby destroying the seedlings, it is advisable to plant them on raised ridges. The dykes thus formed between ridges drain away the water from the roots. To obtain good blossoms the plants should not be planted deeply, as in such a case only stalks and leaves would appear. It is usual to plant only one seedling in each place, but in the case of inferior seedlings two are sometimes planted together.

Cultivation of pyrethrum in Hokkaido begins with the sowing of the seeds in spring and the transplanting to farms in autumn of the seedlings grown from those seeds. No crop is expected in the following year, which is given over to weeding. In the second year, however, flowers can be picked, though in the Kamikawa district, which is the centre of cultivation in Hokkaido, the second year's crop rarely exceeds 33 lb. per acre.

As, therefore, the land may be said to yield no crop for another year, seedlings from the second year's sowing are laid aside in another bed and seedlings from the third year's sowing transplanted to the farm. Crops are thus yielded

from the first year's seedlings after the transplanting of the third year's seedlings, and by these methods the ground is most economically used.

(3) *Dividing the Roots.*—After the flowers have been gathered for three or four years the yield falls off appreciably. Old roots are then changed for young or are divided. For division active roots of this age are selected, and the divided portions planted separately. Compared with the seedling plants they are of poor growth, and the season in which their flowers can be picked is short.

(4) *Rotation of Crops.*—As has already been stated, pyrethrum is a perennial. The flower yield, however, decreases after three or four harvests. It would consequently be advantageous to arrange a suitable rotation of crops, but experiments in Hokkaido to this end have unfortunately failed to produce satisfactory results, and the Hokkaido farmers have wisely decided to concentrate on one good crop rather than divide their attentions between two or more indifferent ones.

(5) *Manures.*—In fertile soil excessive application of nitrogenous manures results in a profusion of leaves and an absence of flowers. The principal manure used in Hokkaido is stable litter, but a good auxiliary manure in the form of night-soil, plant ash, fish cake, or superphosphate of lime is also required.

The principal manure is used to prepare the farm for receiving the seedlings at transplantation, and auxiliary manures are applied in autumn after the flowers have been picked. In the latter case the manure is put in the dykes formed by the ridges in which the plants are grown, and the manure itself covered with earth. This manure, if given in autumn, conserves nourishment for the plants through the winter for the following season, but if given in spring a harvest of leaves is reaped and no flowers.

In the Ishikari district about 1 ton of stable litter and 25 lb. each of fish cake and superphosphate of lime are generally used in a year for each ¼ acre of land under cultivation.

(6) *Weeding.*—Systematic weeding should be carried out three or four times a year, special attention being given to the dykes between the ridges.

It is important that the earth in these dykes should

occasionally be turned and crushed in order to prevent the surface of the soil from becoming dry.

Picking

The plants should bear their first marketable crop in the third year after the seeds were sown. In the Kamikawa district the crops amount to some 130 lb. per ¼ acre for the third year, 180 lb. each for the fourth, fifth, and sixth years, and 130 lb. for the seventh year, after which the amount gradually decreases and ceases to be economical.

The chief object of cultivation being to obtain an insecticide, it is important that the season for picking should be when the insecticidal agent in the flowers is most potent. Although the flowers are in full bloom for seven or eight days, the best condition for picking for the purpose of insecticide is when the flower heads are about 70 per cent. open. Picking should in no case be begun before the flower heads have partially opened, as in such an event not only would the yield be small but the flowers would be of inferior insecticidal value.

Experience has proved that to delay picking in the hope of obtaining a larger harvest has more often than not been rewarded by the partial or total destruction of the crop by the rains which usually fall about that time.

In fact the actual date of the picking season varies according to the state of the flower and the climatic conditions of the district in which it is produced. In the Ishikari district, for instance, there are as a rule three pickings, the first on July 3 or 4, the second on July 10, and the third on July 18. The pickers, carrying baskets about 15 in. in diameter and 8 in. deep, advance along the field drawing the stalks through their fingers so as to snap the flower heads off at the neck and drop them into the baskets with one motion. It is claimed that girls can gather from 40 to 80 lb. a day.

This method, while suitable for small farms, is not usually followed on the large ones, where the quicker method of gathering the flowers with their buds attached is the general rule. In the latter case noticeably backward flowers are left to be gathered some five or six days later.

In the districts of Kamikawa and Kutchan, where the plant is cultivated on a large scale, the crops are gathered between July 5 and 10, when the flowers are considered to

have reached the condition most suitable for gathering, by cutting the flowers from their stalks with a sickle and hackling. The disadvantages of this method are first that the flowers so gathered are liable to become soiled by the mud, and secondly that backward, suitably open, and overblown blossoms are indiscriminately mixed together to the detriment of the quality of the powder into which they are subsequently to be made.

Drying

The method of drying most widely practised is to spread the picked flower-heads thinly on straw mats and place in the sun, turning them from time to time so as to ensure even exposure. At night they are taken indoors, and on the following morning brought out and again exposed to the sun. The flowers picked each day are carefully kept in lots separate from those picked on previous and subsequent days. To prevent danger of mustiness and deterioration in quality which frequently accompanies this method of drying, reed mats laid on wooden boards are sometimes used instead of straw matting. Except in times of rain and storm, these can remain out of doors the entire time, and only require the cover of a roof at night to keep off dew; the flowers thus obtain uninterrupted benefit from the wind. By this method drying is completed in five to seven days.

Another method in common use in Hokkaido is to hang the flowers from a drying frame while the stalks and leaves are still attached.

The flowers are considered to be sufficiently dry when they can be crushed to powder by gentle pressure between the thumb and forefinger.

While in Hokkaido drying is usually done in the sun, this method is less effective than drying in the shade, for the former method is naturally at a disadvantage in times of rain and storm.

For drying in the shade, sheds of a size suited to the requirements of the farm are erected in a place through which a good current of air passes, shelves are fitted in the shed and reed mats or straw matting spread on them. After they have been dried in the sun for a day, the flower-heads are spread thinly over the mats in the shed and turned once or twice in 24 hours.

At the end of one or two days of this process, when the flower heads appear to be dry, they are gradually arranged in piles so as to complete the whole process of drying in about five days. This method is more convenient than drying by sun but is less widely used on account of the greater expense involved.

The most advanced method of drying is by artificial heat. Except for manufacturing on a large scale, however, this method is uneconomical owing to the costly apparatus which it requires.

Storage

Flowers must be thoroughly dried before storage, which should be effected in a dry place indoors. If insufficiently dried they will become mouldy and lose their insecticidal power.

Flowers which have been grown from sandy soil should be carefully sifted so as to eliminate all trace of sand. The flowers are packed into boxes, covered with paper and trodden or pressed down so as to fit as tightly as possible into the boxes, which are then closed and hermetically sealed. This method of packing for storage serves a dual purpose, moisture being excluded and economy of space secured.

Where the stalks and leaves are to be used, these when thoroughly dried are made into bundles bound in two places and stood on end in as dry a place as possible. If they are stored in an airless or leaky place mould develops. Should this form on any part of the bundle it rapidly spreads to the whole and renders it useless for commercial purposes.

Packing

In Hokkaido, when the flowers are pronounced fully dried, they are brought in before 3 o'clock in the afternoon, and, if possible, packed on the following day. Formerly the packing material consisted of straw bags, which with their contents weighed some 64 lb. each. After being filled with dried flowers, these bags were encased in straw matting, which was finally stitched at the ends and securely tied with rope. These materials were gradually superseded by gunny bags, which accordingly became the standard packing material under the Inspection Regulations of 1927. Gunny bags must be unlined, but need not be new. They must be of good quality, measure 3 ft. 3 in. long by 2 ft. 4 in. wide, and weigh not less than 2½ lb. When the bags are fully packed the mouths are securely

sewn with strong string or cord. The cost of new gunny bags ranges from 24 to 30 sen apiece, but according to information advanced by the Agricultural Section of the Hokkaido Government Office most of the gunny bags used for packing are those in which the cheaper grades of rice have been imported from India and the Straits Settlements.

In the Kobe district, in order to effect economy in freight, pyrethrum for export is mechanically compressed. The flowers are packed in mat-rush so that each package weighs 112 lb. net, and four of these are assembled in a gunny bag and compressed into a single package some 3 ft. 5 in. by 3 ft. 5 in. by 2 ft. 5 in. This is then bound round with steel bands and removed for export. There are five of these compressed packages to a ton.

The cost of packing by this method amounts to approximately Y4·50 for each package, inclusive of the cost of material.

Cost of Production in Japan[1]

The actual expenses of production naturally vary with the condition of land, area under cultivation, methods of production, and climate. For the purpose of illustration, therefore, it is simplest to take the figures furnished in respect of farms in the Kutchan district, which are operated under a partial contract system, and which are divided for the purpose of cultivation into areas of 50 chobu (about 120 acres) each. The figures follow :—

Cost of Production over a Period of Five Years
(Per chobu = about 2·45 acres.)

	Yen.	Remarks.
1st Year.		
Seeds	7·50	2·5 sho (about 8 pints) at Y3 per sho.
Cost of preparing beds, sowing and weeding . . .	30·00	Sowing area, 1 tanbu (about ¼ acre). Wages of 20 women @ Y1·50 a day.
Cost of preparing main farm and transplanting . .	35·00	Wages for ploughing, Y12.
		,, ,, harrowing (twice), Y4.
		,, ,, ridging, Y2.
		,, ,, planting seedlings, Y12.
		,, ,, carrying plants, etc., Y5.
Total	Y72·50	

[1] *The costs given in this section relate to conditions eight or nine years ago and may not hold good to-day. They will nevertheless serve as a guide to the relative costs of the different operations.*

COST OF PRODUCTION OVER A PERIOD OF FIVE YEARS (continued)
(Per chobu = about 2·45 acres.)

	Yen.	Remarks.
2nd Year.		
Cost of weeding	47·00	Horse-weeder twice, Y7. Hand-weeder 4 times, Y40.
Farm rent	30·00	
Total	Y77·00	
3rd Year.		
Cost of weeding	47·00	As in previous year.
Cost of fertilisers and fertilising	40·00	Herring-cake, soya-bean cake, superphosphate of lime.
Farm rent	30·00	
Cost of straw mats	25·00	100 @ Y0·25.
Cost of straw rope	5·00	20 kan (about 165 lb.) Y0·25 per kan (about 8·27 lb.).
Wages for hanging plants on frame	1·00	
Wages for cutting and drying	32·50	15 women @ Y1·50 5 men @ Y2·00
Wages for packing	37·50	
Cost of gunny bags	7·00	20 @ Y0·30, the balance being accounted for by thread and needles.
Total	Y225·00	
4th Year.		
Cost of weeding	47·00	As in previous years.
Cost of fertilisers and fertilising	40·00	,, ,, year.
Farm rent	30·00	
Cost of additional straw mats and rope	6·00	
Wages for hanging plants on drying frame	1·00	
Wages for picking	32·50	,, ,, ,,
Wages for packing	37·50	,, ,, ,,
Cost of gunny bags	7·00	,, ,, ,,
Total	Y201·00	
5th Year.		
Cost of weeding	47·00	As in previous years.
Cost of fertilisers and fertilising	50·00	,, ,, ,,
Farm rent	30·00	
Cost of additional straw mats and rope	6·00	
Wages for hanging plants on drying frame	1·00	
Wages for picking	32·50	,, ,, ,,
Wages for packing	37·50	,, ,, ,,
Cost of gunny bags	7·00	,, ,, ,,
Total	Y211·00	

On the assumption based on actual experience that only the third, fourth, and fifth years yield crops, of which the average annual output per chobu is 150 kan (about 1,240 lb.),

and that the average market price of the dried flowers for the past few years is Y4 per kan, it may be estimated that the total yield of 450 kan (about 3,720 lb) for a period of five years brings in an income of Y1,800. With the foregoing data the cost of production and average annual income per chobu may now be estimated :—

		Yen.
Income over 5 years		1,800
Expenditure as shown in the foregoing table	786·50	
Cost of equipment	70·00	
Total cost of production over 5 years		856·50
Net income		943·50
Average annual income		188·70

THE DIAMOND DEPOSITS OF SIERRA LEONE

By J. D. POLLETT, A.R.S.M.
Geological and Mines Department, Sierra Leone

ALTHOUGH diamond was first discovered in Sierra Leone more than seven years ago it is only comparatively recently that the existence of this new diamond field has become generally known. The area has been developed so rapidly that, even though exploitation on a large scale has only just commenced, it is already established as one of the principal diamond fields of the world. Large reserves of alluvial diamonds have been located, and many promising areas still remain to be prospected, including extensive lateritic gravel deposits. At the present time the diamond industry is contributing substantial sums in the form of profits tax to the revenue of Sierra Leone, and, except perhaps during periods of depression of the diamond market, it is probable that the country will continue to benefit in this way for many years to come.

Discovery and Early Prospecting

The original discovery of diamond in Sierra Leone was made towards the end of January 1930 by the Government Geological Survey, when a party consisting of the Director, Major Junner, and the writer, his Assistant Geologist, was working in the Kono District. While he was examining the

gravels of the Gbobore stream near the village of Fotingaia in the Nimi Koro Chiefdom, the writer discovered a crystal which subsequent testing in camp that evening with the assistance of the Director confirmed to be a diamond. The

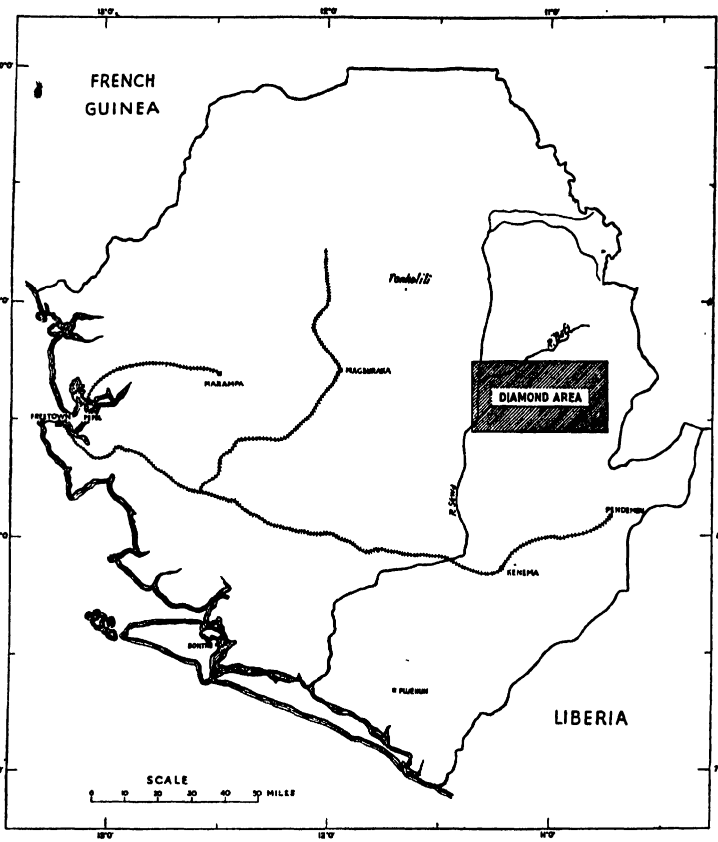

FIG. 1.— SKETCH MAP OF SIERRA LEONE, SHOWING LOCATION OF THE DIAMOND AREA.

next day the Director accompanied the writer to the scene of the discovery, and he also found a diamond. These two diamonds, clear white gemstones weighing about ¼ carat each, were afterwards presented to the Mineral Department of the British Museum (Natural History) at South Kensington, where they are now exhibited.

Although this discovery was announced to the general

public by a notice outside the Mines Office at Freetown, and later on page 11 of the Annual Report of the Geological and Mines Department for the year 1929, it failed to arouse much interest. One or two miners, who were in Sierra Leone at that time examining alluvial gold prospects, visited the area, but, having no special diamond prospecting apparatus, they failed to find any diamonds. Their failure deterred others from making further investigations. Consequently the area was neglected until two events in March 1931 served to bring it again into prominence. Firstly, Major Junner, who in the meanwhile had been promoted to the Directorship of the Geological Survey of the Gold Coast, mentioned the occurrence of diamond in Sierra Leone during a visit to the diamond mines of the Consolidated African Selection Trust, Ltd., at Akwatia, Gold Coast, and acting on this information that company decided to send a prospecting party to Sierra Leone to examine the area. Secondly, the writer made a further discovery of diamond whilst examining the gravels of the Kenja stream, a tributary of the River Moa, near the village of Kpava, in the Kenema District. He found two diamonds of gem quality which weighed 0·22 and 0·55 carats respectively. The discovery, as before, was reported to the public by a notice outside the Mines Office, and later on page 12 of the Annual Report of the department for the years 1930 and 1931.

The prospecting party from the Gold Coast arrived at Freetown on March 15, 1931, under the leadership of Mr. D. K. F. MacLachlan, and included a number of Gold Coast natives who were skilled in the technique of diamond prospecting, and who were admitted into Sierra Leone on the understanding that they would be repatriated when Sierra Leone labourers had been taught this work. The party was met at Fotingaia by the writer, and on their being shown the scene of the discovery, prospecting pits, each 5 ft. long by 2 ft. wide, were dug at intervals of 100 ft. in a line across the alluvial flat of the Gbobora stream at this spot. After three days' work small diamonds were recovered from some of the pits on the left bank of the stream.

Prospecting Equipment

The party brought with it special diamond prospecting equipment consisting of shakers and Joplin jigs. A shaker,

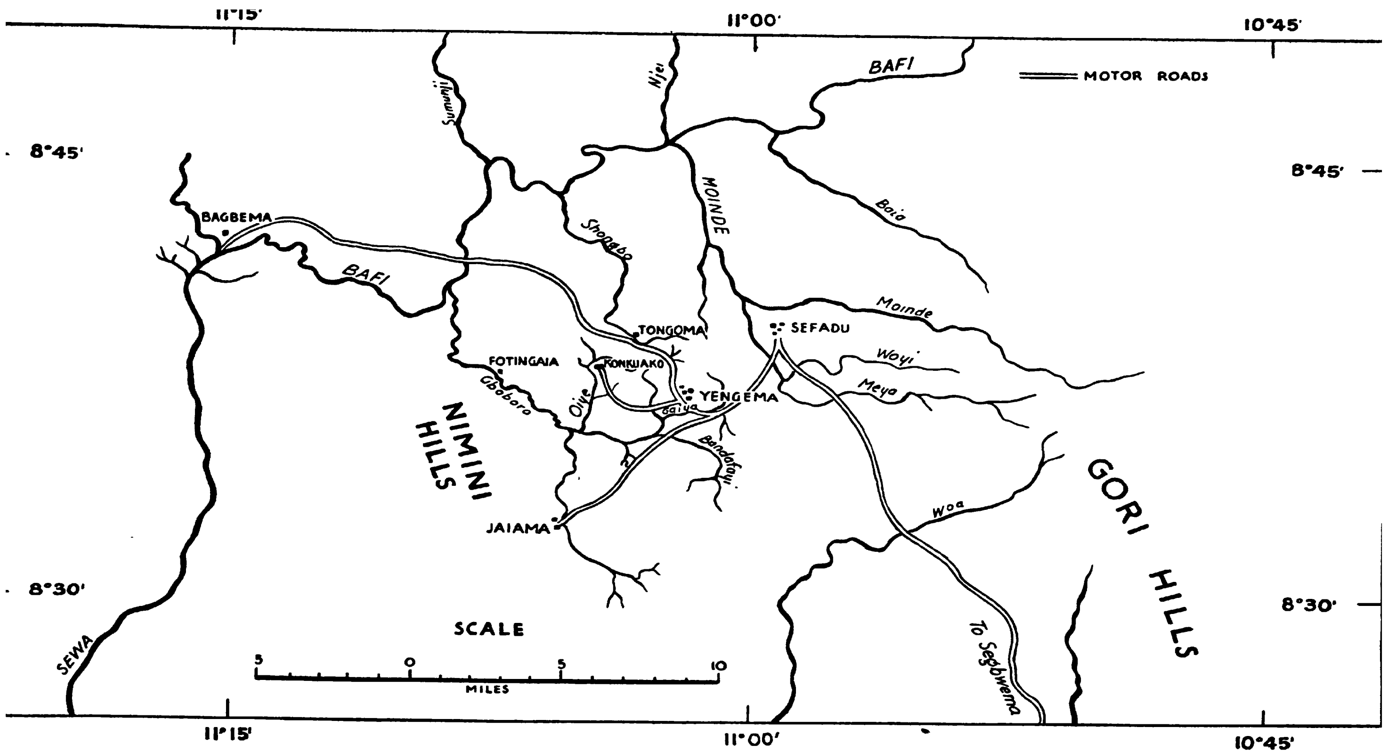

FIG. 2.— SKETCH MAP OF THE DIAMOND AREA OF SIERRA LEONE.

or rocker as it is sometimes called, consists of a cradle supporting a nest of screens in the form of rectangular trays, usually three in number and each one removable, the top screen having the largest mesh and the bottom the smallest. The actual sizes of the screens that should be used depend upon the size of the diamonds in the deposit, and in Sierra Leone 8 mm., 4 mm., and 2 mm. mesh have been found satisfactory. The gravel to be tested is fed on to the top screen, and the shaker is given a rocking motion while water is poured on to wash the gravel. It is the practice in West Africa for two boys to mount the shaker, and standing one at each end, to impart this rocking motion by a peculiar jerking action of their legs. In this way the gravel is washed free of clay and classified into separate sizes according to the mesh of the screen employed. The fine material of less than 2 mm. size is allowed to run to waste as it has been ascertained that there are very few diamonds of this size in the Sierra Leone deposits. In other fields where small stones are more common a 1 mm. mesh screen is incorporated in the cradle.

The over-size gravel from the 8 mm. screen is handpicked for diamond, and the other sizes are treated separately in the Joplin jig. This consists of a rectangular screen of either 1 mm. or 2 mm. mesh in the form of a tray suspended above water from a beam pivoted on a raised support. The sized gravel is placed in the jig tray, and this is then lowered into the water and given a jigging motion with a short sharp stroke by a native holding the far end of the beam. The heavier material finds its way to the bottom of the jig tray by the action of gravity, and the lighter tailings are scraped off the surface periodically. When sufficient concentrate has been collected it is removed to a pan and examined under water for diamond.

This apparatus has been found very satisfactory where the prospector's work is confined to one locality, but on account of its bulk it is not as portable as might be desired, and recently it has largely been replaced by hand sieves and gravitators. With these the gravel is washed and sized as before and then concentrated in the gravitator. This is a wooden sieve of about 1 mm. mesh. The gravitator is first given a jigging motion in water which concentrates the heavier minerals in the gravel to the bottom, and then a series of jerks

which swirl the gravel round and cause the concentrate to collect towards the centre of the screen. The gravitator is tipped over quickly and the gravel deposited on a flat surface so as not to disturb its formation in the gravitator, and any diamonds are picked out from the circular patch of concentrate.

Later Developments

Having obtained confirmation of the occurrence of diamond, Mr. MacLachlan applied to the Sierra Leone Government on behalf of his company for a Special Exclusive Prospecting Licence over the area surrounding the two discoveries. After lengthy negotiations it was decided on the advice of the Colonial Office and of the Gold Coast Government, that it would be in the best interests of Sierra Leone and the diamond industry as a whole for the development and exploitation of the new diamond field to be in the hands of one responsible company, and the Consolidated African Selection Trust, Ltd., was given the exclusive right to prospect for diamond over an area of 4,170 sq. miles of the eastern district of Sierra Leone.

Additional prospecting staff was sent to Sierra Leone, and their preliminary work was to determine whether the two diamond occurrences were part of some major area of distribution. It was soon seen, however, that the two areas were not associated, and, as the area near Fotingaia seemed to offer the greater possibilities, further prospecting was devoted mainly to disclosing the salient features of the spread of the diamonds in this locality. The earlier work indicated the presence of several deposits of rather small diamonds in the Gbobora stream and its tributaries, the Bandafayi and Oyie streams, but it was not until the middle of 1932, when diamonds were found to the north of the Bandafayi watershed in the Shongbo stream near Tongoma village, that it was established that deposits of undoubted economic value existed in Sierra Leone. The average size of the diamonds in this deposit was about two to the carat, and a high percentage of these stones were of gem quality. This discovery led to a considerable increase in the prospecting staff during the years 1933 to 1935, and their work showed that the focus of distribution of the diamonds was a comparatively small area centred around the village of Yengema, and that the shed was from east to west in direction. Mining was commenced on a small scale

on the Shongbo deposit towards the end of 1932, and the recovery obtained exceeded that anticipated from the prospecting data. It was found that the diamonds tended to gather in clusters on the bedrock, especially beneath boulders and where there were small potholes, and that representative samples such as would be required from pits dug to evaluate a deposit could be obtained only if a larger quantity of gravel were treated. On this account it was decided to increase the size of the pits used above that commonly employed in the Gold Coast where the diamonds are so much smaller and more evenly distributed throughout the gravel. As an additional check, deposits were bulk-sampled before permanent diamond recovery plant was erected.

Prospecting results had shown that all the streams where deposits had been located formed part of the Bafi-Sewa river system, and a rapid prospecting reconnaissance of these rivers made in the early part of 1933 indicated that diamonds had been transported at least as far as the tidal reaches of the River Sewa below the town of Sumbuya. More detailed prospecting was carried out later in the same year, and this confirmed not only that valuable deposits were likely to be found in the River Sewa gravels, but that deposits also occurred in some of the tributary streams within the confines of the Sewa valley. These latter deposits were evidently reconcentrations of old Sewa terrace gravels. Several such deposits were located in the gravels of small tributary streams near the confluence of the Bafi and Bagbe rivers near the village of Bagbema, and some of these were developed and afterwards mined, recovery being effected by Pleitz machines or Joplin jigs.

Sierra Leone Selection Trust, Ltd.

As the River Sewa was not included in the area held under its Special Exclusive Prospecting Licence, the company entered into further negotiations with the Government with a view to obtaining sole control of prospecting for and mining diamond in Sierra Leone. These negotiations culminated in an agreement, ratified in the Legislative Council towards the end of 1935, under which the sole right to prospect for or mine diamond in Sierra Leone (except in the Marampa and Tonkolili iron ore concessions, where the right to mine all

minerals had already been granted to the Sierra Leone Development Company, Ltd.) was given for a period of 99 years to a new company to be known as the Sierra Leone Selection Trust, Ltd., whose shares were to be held entirely by the Consolidated African Selection Trust, Ltd. It was also agreed that the Government of Sierra Leone should participate in the profits arising from the mining operations of this company in Sierra Leone to the extent of 27½ per cent. of the annual net profit, and that the company should compound its mineral rents in an annual payment of £7,000, which would be paid into the Protectorate Mining Benefits Trust Fund.

Under the ægis of the new company one of the most up-to-date permanent mining camps in West Africa has been constructed about a mile to the east of the village of Yengema. It consists of a number of bungalows, each supplied with electric light and running water, for the European staff, houses for African clerical and artisan staff, labour lines, a well-equipped hospital, barracks and office for a diamond protection police force, stores, machine shops and power station, a diamond sorting house and a spacious office. A large area of bush has been cleared around the camp and replanted with a short-growing variety of grass; a well-stocked orchard and vegetable gardens have been prepared, and the vicinity of the camp has been planted with many hundreds of ornamental and flowering trees, shrubs, and plants. The main camp has been connected by road to the Protectorate road system at Sefadu, and roads have been constructed to Bagbema and to the main deposits around Yengema.

Diamond Winning

Three of the major deposits have been equipped with electrically driven machinery and plant for their exploitation on a large scale. Owing to the general nature of the deposits, the method of treatment is to work each deposit as a separate unit complete with its own electric power plant.

The method of working a deposit is as follows:—A drainage cut is dug along the length of the area to be mined in such a position as to drain subsequent working cuts. A key cut is then made, usually across the full width of the deposit, from which all overburden and gravel are excavated. Mining

PLATE III

SIERRA LEONE: ALLUVIAL DIAMOND MINING.

Reproduced from a Diorama in the Exhibition Galleries of the Imperial Institute.

[facing page 340

of the deposit proceeds with a series of working cuts, each dug approximately parallel to the key cut. The overburden from the first working cut is dumped on to the cleaned bedrock of the key cut, and the gravel thus exposed is transported in wheelbarrows along a track of timber planks to a bin near the diamond recovery plant. Care is exercised in cleaning all the gravel from cracks and crevices in the bedrock as it is there that the diamonds tend to segregate. Each successive cut is treated in a similar manner until the whole area has been mined.

The gravel from the bin is elevated by means of a conveyor belt to a grizzly on the diamond plant which removes the larger stones, and then passes to a washing trommel and afterwards to a sizing trommel. The oversize from this is hand picked as it passes along a belt to waste, and the undersize is fed into a circular concentrating pan.

The gravel in this pan is agitated in water by a series of revolving arms to each of which is attached a number of knives, or tynes as they are called, and concentration is effected mainly by the centrifugal action so produced. The tailings are discharged over a gate fitted in the inside rim of the pan, and the concentrates collect toward the outer rim whence they are drawn off periodically.

The tailings from the first pan are treated in a second pan to recover the few diamonds that may still remain, and as the tailings from this pan are discharged they are removed from the plant in wheelbarrows or trucks and spread over the worked-out area which is thus left clean and level.

The concentrates are sized into five separate divisions in a sizing trommel, and each sizing is further concentrated by a water classification in jigs. The heavier minerals associated with diamond in the deposits are collected with the diamond, and the other gravel is sent away as tailing.

This heavy concentrate is next treated by sending it over narrow shaking tables covered with a special grease compound to which diamond adheres to a greater extent than the other heavy minerals which pass on as tailing. The grease is scraped off the tables periodically and is placed in a small trommel. This is revolved in boiling water to melt the grease and free the diamond and other concentrate. The diamond is recovered from this concentrate by hand picking.

Output and Description of Stones

The diamonds thus won include all classes from the poorest diamond, which is known as bort and is used for industrial purposes, to gemstones of first quality. The percentage of industrial to gem-quality diamond varies widely in the different deposits, and by regulating the supply from the several mining areas it is possible to meet the varying demands of the diamond market. In regard to richness also, there is variation, not only between one deposit and another, but also in different parts of the same deposit. In some of the richest deposits small areas have given values up to 250 carats to the cubic yard, but, needless to say, such rich spots are exceptional. The diamonds also vary much in size, from small stones averaging ten or twelve to the carat to a stone of medium quality weighing 144 carats. One gemstone of fine quality weighed 78 carats and was sold for more than £5,000, but such stones are rare.

It is fortunate that the period of development of the field has coincided with a period of increasing activity on the diamond market, as this has enabled the field to be developed more rapidly than would otherwise have been possible. The following figures showing the sales value of production bear striking testimony of the rapidity of the development :—

	£
Year ending June 30, 1932 . .	20
,, ,, ,, 1933 . .	4,485
,, ,, ,, 1934 . .	99,971
,, ,, ,, 1935 . .	120,508
,, ,, ,, 1936 . .	500,124

The diamond output of the mines is weighed and roughly classified in Sierra Leone, but the main classification and valuation is made in London by expert valuers. For the purpose of making this valuation the bort is separated from the gemstones, and the latter are classified into 65 to 70 different categories according to the quality, colour and size of the diamonds, each category being valued separately. After the valuation has been completed, different parcels are made up and offered for sale through the organisation that has been established for controlling the marketing of diamond to the trade. The parcels have been well received.

As is the case with the stones of most diamond fields, the

Sierra Leone diamonds have certain characteristics that enable the expert to distinguish them from those produced from other areas. Perhaps their most outstanding characteristics are: (1) the green colour that is almost general in the bort, quite common although much less pronounced in the translucent and coated varieties of diamond, and faintly discernible or absent in the gemstones; (2) the prevalence of the octahedron form; and (3) the comparatively large proportion of water-clear or "glassy" cleaved octahedra amongst the gemstones. Other colours and crystal forms, however, are by no means absent, the bort, for instance, being sometimes coloured grey or a yellowish-brown.

Most of the bort is of a deep olive-green colour and occurs in crystalline aggregates having an irregular or rounded form. When it forms crystals these are usually octahedra, dodecahedra, tetrahedra, or cubes. Macles (i.e. diamond crystals twinned by rotation on the plane parallel to the opposite faces of the octahedron) occur, and a cubic penetration twin according to the fluorite law has been observed. Stewartite, a variety of bort having a cindery appearance and occurring in shapeless lumps, and framesite are also sometimes found. Broken fragments of bort sometimes show a translucent or even transparent core with an opaque green skin.

Some stones occur with a thin skin or coating of colour beneath which may exist a gemstone of good quality. Other gemstones contain small dark-coloured inclusions which may perhaps be graphite or ilmenite, and such stones are known to the trade as "spotted." Spotted and coated gemstones offer a speculative interest to the diamond cutter in that the amount of profit obtainable from such stones is dependent upon his skill and judgment in cutting them. The crystals of gemstone class, when of good shape, occur mainly as octahedra, sometimes as dodecahedra, and far less frequently as cubes. Diamond has a perfect cleavage in the four directions parallel to each pair of opposite octahedron faces, and water-clear, cleaved octahedra are common. Irregular crystals, however, are more numerous than those of good shape. Often the four pairs of opposite faces of the octahedron are not equidistant; the crystal then tends to assume a tabular habit, and when this is very pronounced the resulting crystals are known as "flats." Flats and macles are quite common. Many of the crystals

have curved faces and also have striations near their edges. Often the main crystal form is modified by additional faces at the sides or corners, and some stones consist of irregular crystalline aggregates. Fractured and broken stones are fairly common and these are often due to the presence of a small inclusion of some foreign material that has caused internal strain. Many of the stones show varying amounts of wear on their corners and edges.

Geology and Topography of the Diamond Field

The main diamond area is situated in granite country on a plateau in the Kono District in eastern Sierra Leone. The elevation of the plateau is in general between 1,000 ft. and 1,500 ft. above sea level, but ranges of hills, of which the more important are the Nimini Hills to the south-west of the area, and the Gori Hills to the south-east, rise to more than 2,400 ft. above sea level. To the north-east, the Tingi Mountains form part of the southern escarpment of the higher Tembikunda Plateau from which the principal headwater of the River Niger rises and flows in a north-easterly direction. The highest peak in this range is Sankan Biriwa with an elevation of about 6,000 ft. About 30 miles to the north-west of the Tingi Mountains is the isolated range of the Loma Mountains, of which Bintimani, 6,390 ft., is not only the highest peak of the range but also the highest mountain in Sierra Leone. These two mountain ranges are composed of granite, but at the crest of Bintimani the granite is capped by a sheet of olivine-dolerite more than 200 ft. thick. These high peaks are evidently the remains of a former higher plateau, and all the northern headwaters of the River Bafi rise in this area.

The granite is intrusive into a series of ancient schists of both sedimentary and igneous origin. Most of these schists have been denuded away, but some have been preserved in the higher parts of the Nimini and Gori Hill ranges. The numerous included small masses and schlieren of the schists which occur in the granite represent "roöf pendants" of the once overlying schist series in the granite intrusion. Elsewhere in Sierra Leone the schists are well preserved in the Sula Mountains, in the Kangari Hills, the Kambui Hills, and in a small area of the Tembikunda Plateau.

On account of their good development in the Kambui Hills, a southern extension of the Nimini Hills, these schists have been named the Kambui Schists. The Kambui Schists of sedimentary origin are represented by quartzites, hornfelses, phyllites, quartz-magnetite schists, quartz-mica schists, and possibly hornblende schists; and those of igneous origin by amphibolites, chlorite schists, talc schists, and schistose serpentines. The strike of the Kambui Schists throughout Sierra Leone varies between north and north-east, and dips are usually steeply inclined; the schists are thought to be of pre-Cambrian age.

There are two major types of granite; a brown even-grained biotite variety, often strongly foliated, and a grey, fairly coarse-grained biotite-granite with salmon-pink porphyritic crystals of felspar up to 3 in. in length. In some places this porphyritic granite appears to be a later intrusion than the even-grained variety, but this type also shows a certain amount of foliation. There is a tendency for the porphyritic felspars to show alignment parallel to the direction of strike of the schists, and in places the rock has assumed a gneissose character. Locally the granites have been changed through absorption and assimilation of the schists. There is no direct evidence on which to base the exact geological age of these granites, but elsewhere in Sierra Leone, granites are overlain by a sedimentary series, which in its turn is covered unconformably by the Grès Horizontaux Series that is so well developed in French Guinea, and from which graptolites of Silurian age have been identified. It is assumed that the granites are pre-Cambrian. The granites have been intruded by numerous dykes and sills of dolerite, especially to the north of the River Bafi. It is probable that these intrusions are of the same age as the extensive dolerite intrusions into the Grès Horizontaux Series of French Guinea.

The major physical features of the area conform to the directions of the geological strike and dip. The main hill ranges extend in a north-south direction, and most of the streams follow north-south or east-west courses. Especially is this noticeable in the case of some of the tributary streams on the north bank of the River Bafi which have remarkably straight north to south courses. The annual rainfall of the area approximates to 100 in. There are two distinct seasons;

the wet season, extending from June to October, during which most of this rain falls, and the dry season lasting from December to April. The transition periods between these seasons are marked by thunderstorms. The greater part of the area is covered with tall elephant grass, but the stream courses are marked by tree growth, and some of the hill slopes, such as those of the Nimini Hills and the Gori Hills, are forested.

The country around Yengema consists of rolling grass-covered plains from which hills of bare granite protrude. Much of this flat grass country has a surface capping of lateritic gravel, which appears to be of alluvial origin. It is unlikely that the whole of this could have been formed by the existing streams. The gravel in these streams as a rule is angular, but it also contains some pebbles which are so well rounded that it is doubtful whether they have been thus worn by the present streams. It seems possible, therefore, that at some former time a river, larger than any of the existing streams, had its course through this flatter country, and that the plains were formed by this river.

Origin of the Diamonds

Mr. A. C. Clarke, of the Sierra Leone Selection Trust, Ltd., who studied the question of the origin of the diamond deposits while he was at Yengema in 1935, suggests that the Woyi stream or the Woyi-Meya streams may once have had their course in the Gaiya valley, past the Oyie-Shongbo sources and then down the Gboboro valley, and adds that by presupposing a place of origin of the diamonds to the east of Sefadu, near the Woyi stream, the subsequent deposition of the diamonds by the river in these plain areas, with reconcentration afterwards by the present streams, could be made to account for all the known deposits. It seems more probable, however, if there were such a river, that it reached the Bafi by way of the Shongbo valley rather than by that of the Gboboro where there is a marked falling off in diamond concentration. Another possibility is that these plain areas formed part of an ancient course of the River Bafi.

Mr. Clarke also examined the question from the viewpoint of the characteristics of the different deposits. He found great dissimilarity between the diamonds even from neigh-

bouring deposits. There were also marked variations in the proportion of bort, and some deposits were peculiar for the greater clearness of their gem diamonds, others for the large proportion of spotted stones, and another for the larger number of flat stones. These peculiarities could not be accounted for by the grading action of rivers alone, and Mr. Clarke came to the conclusion that they did not support the theory of a common source of origin for the diamonds.

An examination of the heavy mineral concentrates from the diamantiferous gravels has not proved helpful. The most common minerals are variously-coloured corundum, zircon, ilmenite, epidote, rutile, garnet, and occasionally a little spinel and chrysoberyl, but these minerals are characteristics of the granite-schist contacts in other parts of Sierra Leone and apparently have no connection with the source of the diamond. One mineral that has so far been observed only in the diamond area is a much-fractured, dark red, pyrope garnet. Although this mineral is not found in all the deposits and is not very plentiful where it does occur, its presence suggests that the diamonds may have been derived from some basic igneous intrusion.

Altogether the evidence at present available is insufficient to support any particular theory regarding the origin of the diamonds. Several suggestions have been put forward such as that they have been derived from some member of the schists, or from some pipe, or pipes, of basic igneous rock that may have penetrated the granite and which have either been denuded away or have yet to be found. Another possibility is that the diamonds were associated with a member of the dolerite intrusives. In this connection it is interesting to note that alluvial diamonds have been discovered recently in French Guinea, about 80 miles to the east of the Sierra Leone deposits, in association with granites that have been invaded by dykes and sills of dolerite. It is probable that the dolerites in the two areas belong to the same period of igneous activity. The deposits in Kenema District appear to have been derived from the same source as those of French Guinea and to have been transported from that country by the River Moa which rises in the vicinity of the diamond deposits. The diamonds from French Guinea, however, are generally of a poor colour and contain a large proportion of fractured stones, whereas

those from the Kenema District contain a high percentage of gemstones of good colour and quality.

Diamonds are known to occur sporadically over a large area of West Africa, including Liberia, the Ivory Coast, and Nigeria, as well as in French Guinea, Sierra Leone, and the Gold Coast, and it has been suggested that they may have been transported from a common source and deposited by some ancient river. Although it is known that diamonds have sometimes been transported over great distances by rivers, it seems unlikely that these deposits have been formed in this way, especially as the deposits are separated by areas barren of diamond. It is more probable that the various deposits have been derived from local sources. It is to be hoped that increased mining and prospecting of the Sierra Leone deposits will eventually disclose some evidence that will be of material help towards determining the origin of the diamonds. Whether or not the diamonds are ever discovered *in situ*, the field is assured of a long life.

NOTES

Jubilee of the Imperial Institute.—The following talk was broadcast to wireless listeners by the Director, Sir Harry Lindsay, K.C.I.E., C.B.E., on Sunday, July 4th, 1937.

"Fifty years ago to-day, on July 4, 1887, Queen Victoria laid the foundation stone of the Imperial Institute in commemoration of her Golden Jubilee. The Institute was designed to be, and is to-day, a central clearing-house of information about the economic development of the Empire.

"We have analytical and testing laboratories, which started with a staff of three, and now require the services of a large staff of trained scientists and technologists and can tackle, in addition to ordinary chemical analyses, investigations varying so widely as the distillation of essential oils, the production of paper from wood and grasses, or the fabrication of pottery, bricks, and drain pipes from raw clay. Our Intelligence Service, which supplies up-to-date information on the occurrence, utilisation, and marketing of the economic raw materials found in the Empire, has developed steadily in response to numerous demands upon it and now employs geologists, chemists, botanists, and statisticians. Last year the total number of enquiries, written and verbal, which they

dealt with numbered two thousand four hundred. These enquiries reached us from primary producers and exporters in all countries of the Overseas Empire, as well as from importers, manufacturers, and others in the United Kingdom. In this work we have at our disposal the advice and assistance of our two Advisory Councils, one on Plant and Animal Products and one on Mineral Resources, and the fifteen Consultative Committees which work under the supervision of the Councils. The results are published in our quarterly Bulletin, now in its thirty-fifth year, and in our technical monographs on raw materials of the Empire.

"The exhibition side of our work, as well as the scientific side, has progressed a great deal in these fifty years. We try to tell in each show-case the story of some economic product of the Empire, to answer in advance just those questions which rise naturally and spontaneously to the human mind, child or adult. 'What is this?' 'Where does it grow?' 'How does it grow?' 'What use can be made of it?' We try to answer these questions by a running 'story' which links up in a continuous flow photographs of the crop or forest or mine with specimens of the product: more photographs to show the transport and processing with more specimens to show the various stages through which the product passes; and finally the finished product and its use in the home or in the factory.

"The Empire Courts in the building each give, by means of photographs, lighted transparencies, dioramas, and so on, a vivid picture of life and scenery in the Empire country represented, and we have set up a series of statuettes of Empire builders—Cook in our Australian Court and Clive in our Indian Court; van Riebeeck for South Africa; Raffles for Malaya; Cabot for Newfoundland; Rhodes for Southern Rhodesia. Our next additions will be the first Rajah Brooke for our new Sarawak Court; Drake and Raleigh for the West Indies; Gordon and Kitchener for the Sudan. We still need a Wolfe and a Vancouver for Canada, a Livingstone for Northern Rhodesia; and others may suggest themselves.

"Finally, we carry on and supplement the work in our Exhibition Galleries with programmes of Empire sound-films shown in our Imperial Institute Cinema. As our Cinema is naturally used most frequently by schools in or near London the Board of Governors of the Imperial Institute decided in 1935 that we should take over the Empire Film Library which had been collected by the Empire Marketing Board. From this Library we circulate Empire and General Post Office films to some two thousand five hundred schools and educational societies throughout the United Kingdom; and, last year, the aggregate audience exceeded four million seven hundred

thousand persons, most of them school children who have few other chances of seeing Empire films.

"For, to sum up, this is just what we claim to do and to be at the Imperial Institute—on our scientific side, a clearing-house of information about economic developments throughout the Empire; and, in our Galleries, Cinema, and Empire Film Library we are a storyland of the Empire, a vivid storyland and a lively picture-book in one."

The Exhibition Galleries.—A diorama of Mount Everest has been recently placed at the entrance to the East Gallery, in the Indian Court. The diorama, which is of larger size than usual, depicts the northern face of the mountain viewed from a height of about 20,000 ft., and from a distance of some 10 miles from the summit. In the foreground is the main Rongbuk Glacier, which leads to where the mountain towers up in a series of unclimbable cliffs. Below, to the left, is the narrow entrance to the East Rongbuk Glacier, which gives access to the North Col, a high neck of ice linking up with the main north ridge of the mountain, and described as the "key" to the conquest of Everest. It is by this route that attempts to climb the mountain have been made.

To the left of the diorama is an outline drawing on which is indicated by red lines the route followed by the climbers, and by red triangles the sites of the progressive camps; while to the right is a diagram comparing the height of Everest with that of other well-known mountains of the world. A record of the various attempts to reach the summit is also given, together with that of the flight over Mount Everest.

A new court maintained by the Indian State of Travancore has been initiated and a first consignment of samples of the country's products in art and industry has been received and placed on exhibition. This comprises a collection of handicrafts of silver, ivory, coconut shell, and buffalo horn, together with woven silk fabrics and a display of some of the more important of Travancore's plantation and mineral products.

In the main Indian Court a number of photographs, including some obtained with the kind assistance of Miss D. E. Johnston and of the Indian Railways Bureau, have been arranged in one of the photographic swing stands to form a travelogue. Starting at the port of Karachi in Sind the visitor is taken through the length and breadth of India, visiting in turn each of the Provinces and many of the States. The travelogue pictures beautiful shrines, ancient rock temples, snowy mountains, burning plains, busy ports, and quiet villages, and finishes with a view of the tea gardens in Assam.

A bronze statuette of Sir Stamford Raffles, 1781-1826, the founder of Singapore, is now exhibited in the Malaya Court.

This is an addition to the series of Empire Builders and is the work of Mr. Herbert H. Cawood. With the statuette is displayed a short account of Raffles' life as follows :—

" Thomas Stamford Raffles, the founder of Singapore, was born on July 5, 1781, on board a merchantman commanded by his father when off Port Morant, Jamaica. Educated at Hammersmith, he joined the East India Company at fourteen as a clerk. The Company in 1805 sent out to Penang a Governor and staff which included Raffles as assistant secretary. In August 1806 Raffles was appointed acting secretary, and was confirmed in the post in 1807. He also acted as Malay interpreter in addition to his ordinary duties.

" In 1808 his health gave way and he was sent to Malacca for a change. The Company at that time contemplated giving up Malacca. Raffles's report against the proposal so impressed Lord Minto, the Governor-General, that he suspended the evacuation, and in 1809 the Company reversed its decision. In June 1810 Raffles visited Calcutta, and advised Lord Minto on the necessity for the capture of Java, then in French hands.

" Raffles became ' Agent to the Governor-General with the Malay States ' to prepare for the expedition which left in August 1811, and which forced the capitulation of Java in September of that year. He was then appointed Lieut.-Governor of Java, and held that post till he left for England in March 1816. His last appointment was that of Lieut.-Governor of Sumatra from March 1818 to December 1823. During this period he countered the Dutch project for a trade monopoly by founding Singapore in 1819. On his return to England in 1824 he carried out his scheme for founding the Zoological Gardens in London, and gave to it his fine Sumatra collection. He died suddenly on his birthday in 1826.

" His name is commemorated by that of the plant bearing the largest known flower in the world, namely, *Rafflesia Arnoldii*, a parasitic plant native to Sumatra."

To the Uganda mineral collection have recently been added specimens of tin ore, gold, copper, galena, tantalite, and quartz crystals. These samples were received from the Director of the Geological Survey of Uganda.

The " story " of the Nyasaland tobacco industry under the caption " From Seed-bed to Smoker " shows, by means of photographs and specimens, successive stages in the manufacture of pipe tobacco from Nyasaland leaf. Material for this exhibit was presented by the Imperial Tobacco Co. (of Great Britain and Ireland), Ltd.

To the Kenya Court has been added an exhibit of wattle bark comprising specimens of dried bark, chopped bark, and ground bark, and a sample of wattle extract, all provided by the Natal Tanning Extract Co., Ltd. Other recent additions

to this Court are samples of Kenya pyrethrum flowers and photographs showing the manufacture and uses of pyrethrum insecticide.

Specimens of East African sisal fibre and articles made therefrom, received recently through the Tanganyika Sisal Growers' Association, include twines, cords, ropes, clothes-lines, mats, slippers, hats, fishing nets and fishing floats.

Amongst new photographs are scenes in the Gambia and Nigeria, and series illustrating Nigerian butterfat manufacture and the rice industry of the Gambia obtained from negatives kindly loaned by Mr. L. H. Saunders, Department of Agriculture, Gambia; a series illustrating the cultivation of benniseed in Nigeria from negatives by Mr. J. A. Ward, Agricultural Officer, Nigeria; scenery in the Sudan and Uganda from negatives by Mr. C. W. Switzer, District Officer, Uganda; and additions to the cotton, wheat, and maize series from negatives loaned by H.M. Eastern African Dependencies Trade and Information Office, London.

To the South African Court has been added a bronze statuette of Johan van Riebeeck, the Dutch founder of Cape Town and builder of the "Fort of Good Hope." He is depicted by the sculptor, Mr. Herbert H. Cawood, as a strong figure of a man with long hair and flowing moustache. He is garbed in a short flowing cape over closely-buttoned tunic and breeches, and is wearing a Puritan hat, sash and sword, gauntlets and tall cavalier boots. In his outstretched right hand he grasps a long staff. The account of Van Riebeeck's career given in the descriptive label attached to the ebonised pedestal reads as follows:—

"Born at Calemborg, Holland, in April 1618, Johan van Riebeeck was apprenticed to the Guild of Barber Surgeons and qualified when 20. A year later he was appointed Assistant Surgeon to the Dutch East India Company's ship, *Hof van Holland*, which sailed for Java on April 19, 1639. The ship was wrecked off Sierra Leone in July, and he and the other survivors were picked up the following year and eventually reached Java. He then transferred to the secretarial branch of the Company and served in several posts till 1648, when he was sent back to Holland. On the return voyage the fleet called at Table Bay to pick up the survivors of the *Haarlem*, which had been wrecked there the previous year.

"As a result of a memorial submitted by two of the survivors, the Company decided to form a 'place of refreshment for Dutch ships' at Table Bay, and appointed van Riebeeck as Factor and Chief. On April 6, 1652, he landed at Table Bay with detailed orders which he carried out with great energy. He built the "Fort of Good Hope," established friendly relations with natives, and planted crops. In view

of the need for more labour, he suggested that free burghers with their wives should be sent from Holland and that slaves should do the heavy work. Believing the country to be rich in minerals, he sent out in search of them many exploring parties ; he also advocated the formation of a colony, but the Company set their face against this.

" In 1657 Commissioner Rykhof van Goens was sent to report on the Cape Settlement, and he endorsed all van Riebeeck's schemes. The first batch of slaves, obtained from a captured Portuguese ship, arrived in 1658. The treatment of natives by van Riebeeck was always generous and kindly, but by the petitions of the free burghers he was forced in May 1659 to take reprisals which made the natives sue for peace in January of the following year.

" On May 6, 1662, van Riebeeck left the Cape for Java, and he was subsequently sent to Malacca, where his energy succeeded in reviving the prosperity of the settlement. At the time of his death in January 1667, at the age of 58, he was a secretary to the Council of Java."

Two other new exhibits of more than passing interest deal with the production and utilisation of two of South Africa's minerals. The first, kindly provided by Messrs. Johnson Matthey & Co., Ltd., Messrs. George M. Whiley, Ltd., and the Controller of the Royal Mint, is devoted to gold and illustrates, firstly, the winning of the ore and separation of the metal and then passes to gold bars, crude as produced on the mine, and in the refined form most familiar in the banking world. Then follow a series of groups of exhibits, each group isolated on a differently coloured background and each illustrating some application of gold of interest to the " man-in-the-street." One which will appeal to every woman shows how a gold wedding ring is produced ; another traces the minting of the once-popular sovereign. Others deal with the beating of gold-leaf for the use of the gilder, sign-writer, die-stamper, and artist ; the production of coloured gold alloys and " rolled gold " for the jeweller ; liquid gold for the decoration of ceramics ; and gold salts for the plater. Even the gold requirements of the dentist have not been overlooked.

The second mineral exhibit covers the mining of South African corundum and its preparation and grading. The industrial uses of this abrasive are demonstrated by grinding wheels of various types and by non-slip tiles and stair treads.

Exhibition of Coronation Addresses and Messages.—In order to give the general public an opportunity of inspecting the caskets, addresses, and messages received by their Majesties King George VI and Queen Elizabeth from the Colonial Empire on the occasion of Their Majesties Coronation, the

Colonial Office arranged that they should be placed on exhibition at the Imperial Institute, and they remained on view for a period of two months.

In a speech declaring the exhibition open on July 26, the Marquis of Dufferin and Ava, Under-Secretary of State for the Colonies remarked that there was no more suitable place for the display than the Imperial Institute in view of its intimate connections with the Colonial Empire during the last 50 years. The Institute, he said, had staged many exhibitions in its time, but it was doubtful whether it had ever had the privilege of presenting one of such a unique and interesting character. The addresses and messages displayed with the gracious permission of His Majesty had come from widely scattered territories all over the world comprising an area of over 2,000,000 sq. miles inhabited by nearly 60,000,000 people of different race, colour, and creed. The despatches which the Secretary of State had received from the Governors and High Commissioners of these territories described in a most striking way the intense enthusiasm and interest which the Coronation of Their Majesties awakened, and this was reflected very clearly in the addresses and messages to Their Majesties. The messages emanated largely from bodies representative of every class of the community, and in many cases were couched in very simple language which left no doubt of the sincerity of the sentiments of goodwill and loyalty voiced by the writers. While all the addresses submitted to His Majesty from Colonial Governors, Legislatures and Rulers were displayed in the exhibition, it was not possible to include all the hundreds of messages which were received by the Governors and High Commissioners from the many local associations and communities. Many of the addresses, especially those received from Malaya and Ceylon, were beautifully illuminated and in several instances were enclosed in fine caskets of silver, ivory, or rare woods.

The exhibition created a considerable amount of public interest, especially in the case of visitors from overseas. The exhibition was visited by H.M. Queen Mary on August 3.

Colonial Visitors.—The following is a list of officers on home leave from the Colonies who have visited the Institute during the three months May to July 1937.

May 1937

C. H. Croasdale, Administrative Service, Onitsha Province, Nigeria.
J. P. Cunningham, Land and Surveys Department, Nigeria.
G. W. Lock, Agricultural Officer, Tanganyika Territory.
H. Macluskie, Agricultural Superintendent, Sierra Leone.

JUNE 1937

D. C. EDWARDS, Agricultural Officer and Experimentalist, Department of Agriculture, Kenya.
J. A. FAWDRY, Inspector of Mines, Tanganyika Territory.
A. J. FINDLAY, C.M.G., late Director of Agriculture, Zanzibar.
A. W. G. H. GRANTHAM, Colonial Secretary, Bermuda.
T. HIRST, Geological Survey, Gold Coast.
Major N. R. JUNNER, O.B.E., M.C., Director, Geological Survey, Gold Coast.
Captain N. S. B. KIDSON, Secretary to Government, British Solomon Islands.
J. G. M. KING, Agricultural Officer (Cotton Expert), Tanganyika Territory.
Major A. T. LACEY, O.B.E., Director of Education, Nyasaland.
G. A. MITCHELL, Assistant District Officer, Tanganyika Territory.
G. ROBERTS, Director of Public Works, Falkland Islands.
G. R. SAYER, Director of Education, Hong Kong.
K. E. TOMS, Agricultural and Forestry Officer, St. Helena.
E. A. WALTERS, Superintendent of Agriculture, St. Lucia, British West Indies.
G. WALSH, C.B.E., Treasurer, Kenya.
J. H. WARD, Agricultural Officer, Benin Province, Nigeria.
B. W. WHITFEILD, Government Chemist, The Sudan.
E. J. WORTLEY, C.M.G., O.B.E., Director of Agriculture, Trinidad.

JULY 1937

W. J. BADCOCK, Agricultural Officer, Uganda.
C. C. BROWN, British Resident, Pahang, Federated Malay States.
R. H. CAMERON, Veterinary Department, Kenya.
J. V. COLLINS, Government Analyst, Ceylon.
H. C. DOYNE, Agricultural Chemist, Nigeria.
G. GAMBLE, Department of Agriculture, Kenya.
J. HATHORN HALL, C.M.G., O.B.E., D.S.O., M.C., British Resident, Zanzibar Protectorate.
Sir H. HENNIKER-HEATON, K.C.M.G., Governor, Falkland Islands.
G. W. LINES, Agricultural Officer, Nigeria.
A. F. MACKENZIE, Agricultural Officer, Sierra Leone.
E. B. MARTYN, Botanist and Mycologist, British Guiana.
E. M. ROPER, Director, Department of Economics and Trade, The Sudan.
Commander G. A. C. SHARP, D.S.C., Marine Superintendent, Takoradi Harbour, Gold Coast.
Sir EDMUND TEALE, Mining Consultant to Government, Tanganyika Territory
Captain D. THOMPSON, Civil Administrator, Kamaran Islands, Red Sea.
F. B. WADE, Government Geologist, Tanganyika Territory.

All Dominion and Colonial officers, as well as private residents overseas, who may be visiting London are cordially invited to come to the Institute to see our Exhibition Galleries, and to discuss scientific and technical problems in which they may be interested.

The Use of Sisal for Marine Cordage in the Navy.—In connection with the investigation of the suitability of sisal for marine cordage, both by the Imperial Institute and the Admiralty, two reports by the Admiralty have appeared in this BULLETIN, 1933, **31**, 30-39 ; 1935, **33**, 4-13.

In the first of these reports it was mentioned that the results of the departmental trials were considered by the Admiralty as sufficiently promising to warrant the partial adoption of sisal, and that, subject to the price of the fibre being satisfactory, arrangements were being made for it to be employed for certain naval services. In the second report it was stated that the results of trials of tarred sisal had

warranted consideration of the general adoption of tarred sisal cordage in lieu of tarred hemp cordage, and that enquiries were being made as to the extent to which such substitution could be carried out.

A further communication has now been received from the Admiralty, stating that the services for which the use of sisal cordage is at present authorised are as follows :—

Services for which tarred sisal should be used

Boat ropes.
Capstan swifters.
Jiggers and luffs.
Derrick guys.
Lamp halyards.
Accommodation ladder tackles.
Carley float lashings.
Guys to building slip gaffs.
Topping lift falls.
Spring tackles.
Staging lines
Life lines.
Can hook strops.
Springs.
Lower boom guys.
General purpose tackles.
Awning tackles.
Ammunition whips and tackles.
Man ropes.
Spirit-room tackles.
Provision tackles.
Deck tackles.
Derrick purchases and falls.
Shore tackles.
Gantlines.
Bale slings.
Paunch matting.
Breast ropes.

Services for which untarred sisal should be used

Coaling-whip outhauls.
Nose and tail lines for torpedoes.
Awning earrings.
Compressor falls.
Lacings for canvas.
Fixtures, small awnings, blast screens, windsails, boats' covers, canopies, tarpaulins, etc.
Dressing-line whips (tailing).
Awning lacings.
Coaling-whip downhauls.
Burton falls.

Services for which sisal (tarred or untarred) should be used

Guest warps.
Creeper lines.
Collision mat lines.
Sounding-boom gear.
Transporting hawsers.
Buoy ropes.
Hook ropes.
Side screen gear.
Dressing-line downhauls.
Heaving lines.

The Admiralty state that it is under consideration to extend the use of sisal to certain other services additional to those mentioned above.

Economic Development of New Guinea.—An interesting paper by Dr. W. C. Klein, Secretary of the Netherlands New Guinea, published in *The Asiatic Review*, 1937, **33**, 566-580, compares the development of the resources and trade of Dutch New Guinea with that part of New Guinea which is controlled by Australia (Papua and the Mandated Territory). By means of statistics of exports he shows how in the exploitation of forest produce, such as gum copal, timber, rattans,

nutmegs and mace, Dutch New Guinea is ahead of the Australian regions. This the author attributes partly to the skill of the Chinese trade in the former country in inducing the natives to bring certain of these products to the trading stations, whereas in Papua the traders are wholely, and in the Territory of New Guinea mainly, Europeans. As regards gum copal and nutmegs the trees are practically confined to the Dutch territory.

In the case of plantation products on the other hand there is a marked superiority in quantity and value on the Australian side. The most important of these is copra, which in the Mandated Territory and in Papua is produced mainly on European-managed plantations, whilst in the Dutch territory the bulk is native copra. The success of the industry in Australian New Guinea is considered to be due to a large extent to the more reliable labour supply, the better shipping facilities, and the proximity of the Australian market. The system of marketing is also better on the Australian side, being more in the hands of large firms.

Surprise is expressed that, in spite of the export bounty, the scientific work of the local Agricultural Department and the favourable soil conditions, the cocoa industry of the Territory of New Guinea does not make greater progress, especially in view of Australia's large imports of this commodity from West Africa and the West Indies. It is suggested that this may be due to the native Kanakas being less intelligent than the Gold Coast natives, a fact which the author says accounts for the failure of the few cocoa experiments which have been made on the Dutch side.

Papua is the only territory of New Guinea which is exporting rubber.

Another product confined to the Australian side is desiccated coconut, which is now being made in both Papua and the Mandated Territory to supply the Australian market.

Metals also have hitherto only been produced in Australian territory, viz., copper in Papua and gold in both Papua and the Mandated Territory, especially the latter. A big prospecting campaign for gold has, however, been started in Dutch New Guinea.

A consideration of the value of the total volume of trade (exports and imports) shows that whereas in the Dutch territory the increase during the thirty-year period commencing 1905 amounted to 70 per cent., in Papua it rose 300 per cent., whilst in the Mandated Territory the increase was no less than 1,600 per cent. In the early days the exports from Dutch New Guinea exceeded the imports, whereas on the Australian side the reverse was the case. That is to say the Dutch were taking out all they could from their territory

whilst in the remainder of the country money was being put in for its development. This sounder policy is now reaping its reward for the Australians, and it is only in the last few years that the Dutch have been spending increasing sums of money on development, largely in connection with the exploration of gold already mentioned, and also in a search for oil.

Experiments on the Packing of Passion Fruit Juice.—In connection with an enquiry received in 1936 from East Africa regarding the preparation and marketing of passion fruit juice, the Imperial Institute consulted the Metal Box Co., Ltd., as to the type of can best suited for packing the juice. Apparently no work had hitherto been done on this subject, and the firm arranged for appropriate trials to be carried out at the Fruit and Vegetable Preservation Research Station of the University of Bristol at Campden, Gloucestershire. A copy of the report on the experiments has been furnished to the Institute, and with the kind permission of the Director of the Station, Mr. F. Hirst, M.Sc., A.R.C.S., and of the Metal Box Co., Ltd., the report is printed below for general information.

University of Bristol Research Station, Campden, Glos.

Report on Passion Fruit Juice and Cordial

Passion fruit juice was prepared from fresh fruit and packed in three different types of cans, plain open-top cans, lacquered open-top cans, and wax-lined beverage cans. A number of glass bottles were also packed as controls. To one portion of the juice, sugar was added to give a cordial of density 45° Brix, and a similar series of tests was carried out on this product. The full range of tests was as listed in the following table :—

(*a*) *Unsweetened Juice.*

Containing no preservative but pasteurised 20 minutes at 170° F.

(1) Open-top cans—plain.
(2) Open-top cans—lacquered.
(3) Bottles.

(*b*) *Unsweetened Juice.*

Not pasteurised but containing benzoic acid as preservative.

(1) Wax-lined cans.
(2) Bottles.

(*c*) *Sweetened Juice.*

As tests (*a*).

(*d*) *Sweetened Juice.*

As tests (*b*).

The cans and bottles were examined after three months'

storage at ordinary temperature during the autumn months, with the following results.

The product obtained in open-top cans was perfectly satisfactory. There was practically no difference between any of the containers, so far as colour and viscosity were concerned. The flavour of juice and cordial packed in lacquered cans was not quite so good as that from the plain cans, though the difference was so slight as to be apparent only when two samples were being tested side by side. The condition of the containers was quite satisfactory and no excessive corrosion was noted.

The juice and cordial preserved with benzoic acid differed quite considerably in appearance from that which had been sterilised by heat. Three samples out of four examined had separated into two layers, a clear pale yellow liquid and a thick brownish-yellow sediment. On shaking, the material could be mixed to a liquid resembling the fresh juice in colour and appearance, but much less viscous, i.e. more watery in texture. Apart from this defect the colour was satisfactory and the flavour quite good, though a slight off-flavour due to the preservative could just be detected.

On the results of this examination, the product packed in open-ended cans appears to be quite equal to the bottled product, and there is no advantage to be gained by using lacquered cans. With regard to the juice preserved with benzoic acid, it seems likely that the difference in viscosity between this and the sterilised product might be due to the fact that no heat treatment had been given to the material containing preservative. This point might be investigated with advantage, and it is also possible that the wax-lined cans might be used for juice or cordial containing no preservative, but given a pasteurization at some temperature below 170° F. Such a product would remain good for a considerable time after a can had been opened as the extremely high acidity of this material renders it less susceptible to the attack of micro-organisms.

The Ethylene Treatment of Tobacco.—The effect of very small quantities of ethylene on the ripening (colouring) of fruits is well known, and this gas is now being employed on a commercial scale in the United States, the Union of South Africa, and elsewhere, particularly in connection with citrus fruits. The effect of the gas on the ripening of fruits is recognised to be due to stimulation of the enzyme processes, and, since the changes which take place during the curing of tobacco are also related to enzyme action, it has been suggested that the quality of the leaf might also be favourably influenced by the action of ethylene. Hitherto, not much work has been

done in this direction, but the matter has been taken up by the Agricultural Adviser to the Colonial Office and arrangements are being made for experiments on the gas treatment of tobacco to be carried out in certain tobacco-producing countries in the Empire. For the benefit of those concerned with such experiments the Imperial Institute has prepared summaries of two papers dealing with work on these lines which has already been done in Germany and Italy, and these are printed below.

The results of the German experiments are recorded in a paper by Dr. G. Pfüster and Dr. H. Losch, published in *Die Umschau*, Vol. 39, No. 11, March 10, 1935, pp. 202-206. The authors undertook experiments with tobacco primarily with a view to ascertaining whether a good ripe yellow colour could be obtained with certainty by means of very small quantities of ethylene or acetylene. They found that the ripening of tobacco could be accelerated by the same substances as are effective in the case of fruits, and that these include, in particular, " narcotic " gases such as ethylene, acetylene, and nitrous oxide. These gases can be used in very high dilution, e.g. ethylene in the proportion of 1 in 1,000, or 1 in 100,000, or in some cases 1 in 1,000,000 parts of air has a definite effect on enzyme action in plant cells. Such minute traces obviously can have no deleterious effect on the tobacco or on the health of the smoker. Their action may be regarded as similar to that of an activator in catalysis.

In the authors' experiments ethylene-air mixtures in the proportions 1 in 5,000 to 1 in 10,000 were generally employed; sometimes rather more concentrated acetylene-air mixtures were used.

In order to carry out tests the freshly gathered leaves were divided into three portions, two of which were placed in airtight chambers into one of which the gas was admitted, whilst the third went into the tobacco shed. Conditions in the two chambers were the same, temperature being between 20° C. and 25° C. and atmospheric humidity about 90 per cent. They were " aired " each day to remove carbon dioxide which would retard the ripening process, a fresh dose of ethylene being admitted each time to the treatment chamber. Later an arrangement was devised for removing the carbon dioxide continuously by means of a rotary pump and suitable absorbent materials, this having the additional advantage of ensuring circulation in the atmosphere of the chamber.

It was found that in the case of leaves picked at the normal time or 8 to 10 days earlier, those treated with gas showed a yellow colouring earlier and more strongly than those in the other chamber, the leaves in the tobacco shed being the slowest to show any yellowing at all. Leaves that

had been picked 3 weeks before the normal time would not develop a good yellow colour, even in the gas chamber, but turned to olive-green or brown tints.

Tests of treated and untreated tobacco (after fermentation) for smoking qualities (flavour and aroma) showed very marked superiority in the case of the treated material. Thus the flavour of an untreated sample was described as " sharp and poor "[1] (beissend und leer) and its aroma as " not quite pure " (nicht ganz rein), whilst in the case of the corresponding treated material the flavour was pronounced " rather full, not unpleasant " (etwas voll, fast angenehm) and the aroma " pure, somewhat flowery " (rein, etwas blumig). The " character " of the tobacco in respect of those qualities that determine its gradation from " heavy " to " light " was in general unaffected by the gas, though in some cases it was rendered definitely " lighter."

The influence of ethylene treatment on nicotine content was found to depend on its duration, the first effect being to produce an increase, but the final result being a decrease. The authors do not attempt to correlate smoking qualities and nicotine content, but state that in their investigations the greatest improvement in quality by gas treatment did not coincide with the maximum reduction in nicotine content.

Experiments were also carried out in exposing the leaf to ethylene during fermentation, the gas being introduced either in one dose or in successive doses at intervals of a few days. The treatment had a markedly favourable effect on the flavour and aroma of the tobacco which were described respectively as " pure and full " (rein und voll) and " pleasant, somewhat flowery " (angenehm, etwas blumig), whilst the corresponding reports on untreated tobacco were " rather unpleasant and poor " (etwas unangenehm und leer) and " rather impure " (ziemlich unrein). It thus appears that gas treatment during fermentation is as advantageous as that of the freshly gathered leaves.

The effect of prolonged gas treatment was tried with a view to ascertaining whether it would be possible by this means to dispense with fermentation. Leaves exposed to ethylene (1 in 5,000) for six months and not fermented were actually judged more favourably as to smoking qualities than untreated but fermented leaves. In practice, treatment requiring such long duration would not show any advantage over fermentation as ordinarily carried out, but the result is regarded as theoretically interesting.

Finally, the authors find that even finished tobacco goods, i.e. pipe tobacco, cigarettes, and cigars, especially those of

[1] In view of the difficulty of translating exactly the terms used in describing smoking qualities, the German words are added in brackets.

poor quality, may be improved in aroma and flavour (if only to a very moderate degree), by gas treatment, showing that the activity of the enzyme is not quite destroyed even in tobacco that has been fermented, heated, and dried in storage.

The results of preliminary experiments carried out by Dr. U. Rossi in Italy are described in the *Bollettino Tecnico del R. Istituto Sperimentale per le Coltivazioni dei Tabacchi "Leonardo Angeloni," Scafati (Salerno)*, Vol. 30, No. 4, October-December, 1933, pp. 221-258. The author states that ethylene gas, at suitable dilution and under proper conditions of temperature and moisture, exerts a stimulant action on tobacco leaves resulting in a considerable acceleration of the various changes that follow their harvesting. Trials made with a number of different varieties of tobacco showed that the time necessary for curing may be reduced, in general, by about 40 per cent. He claims that ethylene treatment improves the aroma, colour, and burning qualities of tobacco. The gas does not itself enter into any chemical combination in the leaf, nor does the treatment lead to any secondary reactions having adverse effects on the finished product.

It is pointed out that the process is not only advantageous for improving the quality of poor tobacco. In the case of highly priced oriental tobaccos, the youngest leaves of which do not reach maturity at the required time, the ethylene treatment of these leaves, provided they have attained a sufficient degree of development, will bring them to maturity and enable them to be cured satisfactorily. It is also of special value in the case of late ripening varieties of tobacco such as Maryland, which under some climatic conditions barely succeed in reaching the stage of maturity necessary for commercial utilisation. There again, the plant must have arrived at a certain degree of development in order that the treatment may be effective.

It is also claimed that ethylene treatment, by maintaining the turgidity of the cells, decreases the rate of drying of the leaf and so reduces the risk of "green" drying when the weather is exceptionally dry or windy.

Finally, the stimulating effect of the gas on the enzyme actions continues for some time after its application has ceased, so that all those further changes that take place between the curing and the finished product are completed in a shorter time than would otherwise be the case.

The author makes the following recommendations for carrying out the process.

The chamber used should be of ample size to allow ready access to all the material to be treated. The temperature should be between 21° C. and 28° C., and should be kept as steady as possible. If the temperature is too low the removal

of the chlorophyll is inhibited, and at 15° C. the transformation of the green leaf is almost completely arrested. The precise optimum temperature is different for different varieties of tobacco, being in general that best adapted for the natural growth of the plant. The air in the chamber should be kept changed in order to remove carbon dioxide and any other objectionable products of decomposition. The atmospheric humidity should be maintained between 75 per cent. and 80 per cent. In order that the treatment may be effective the leaves must have reached a stage of development at least nearly approaching physiological maturity. It is also desirable that they should not have been harvested following heavy rain.

The Tonka Bean.—The tonka bean tree, *Dipteryx odorata* Willd., belonging to the natural order Leguminosæ, is a large forest tree attaining heights up to 80 ft. and sometimes considerably more. Its principal native habitat is in Venezuela, but it also grows in Colombia and the Guianas and it is cultivated in Trinidad.

It thrives on many kinds of soil, but does especially well on well-drained gravelly or sandy ones. Heavy waterlogged soil and impervious clay are unsuitable for it. It is stated to require a minimum annual rainfall of about 50 to 60 in., well distributed, though it will withstand a certain amount of drought.

The tree can be propagated in several ways, the easiest being by seed, which should be sown at stake as the young plant does not transplant well. The seeds require about 6 weeks to germinate, and the tree generally takes from 7 to 15 years to come into bearing.

When grown alone the best planting distance is generally considered to be about 50 trees to the acre, but the tree is also sometimes grown as wind-breaks, for example, with cocoa.

The yield from any individual tree varies considerably from year to year, in fact it is sometimes stated that there is a regular alternation of good and bad years. The average yield in the case of full grown trees is about 10 lb. of beans per annum.

The fruit, or seed pod, of the tree resembles a large plum and is pale brownish-yellow when ripe. The chestnut coloured seed is the tonka bean of commerce. The fruits are not gathered from the trees, but are picked up from the ground after they have fallen. They are spread out to dry till the pulp has shrivelled, after which the shell is easily cracked and the seeds removed. These are dried in the open and then cured.

Curing consists in steeping the beans in strong rum for

two or three days, after which the rum is run off and the beans left spread out till the spirit has evaporated, when they are ready to be packed for shipment. The beans contain an odoriferous substance called coumarin, and the effect of the curing process is to make part of the coumarin crystallise on their surface, imparting a characteristic " frosted " appearance that is prized by users.

The greater part of the world's supply of tonka beans are produced in Venezuela, but most of these, together with locally grown beans, are cured in Trinidad, whence they are shipped to the consuming countries, principally to the United States; only relatively small quantities come to the United Kingdom.

The commercial value of tonka beans lies in the coumarin that they contain. Their principal use is in the tobacco industry, the powdered beans being mixed with tobacco in order to impart to it an agreeable odour. Extracts from the beans are used for various purposes in perfumery, whilst the powdered beans are used, with other materials, in perfume sachets. Extracts are also employed to some extent in confectionery.

Exploitation of Babassu Nuts in Para.—The babassu palm (*Orbignia Martiana*) covers a very wide area in Brazil and in recent years considerable interest has been taken in the commercial exploitation of the nuts. These yield an oil similar in character to palm kernel oil and suitable, like the latter, for edible purposes, and for soap making and other industrial uses (see this BULLETIN, 1917, **15**, 38; 1929, **27**, 286).

According to a report by the Acting British Consul, Para, a concession for 30 years was granted on December 17 last by the State Government of Para to the Companhia Industrial Brasileira de Babassu for the cultivation of the babassu palm tree and the treatment of the kernel, either for the export of the kernel, or for the expression of the oil. This product has never been an appreciable export from the Amazon, but quantities are known to exist on the upper reaches which have never been exploited. By the concession now granted the Company undertakes to start building, within 18 months of the date of the contract, a factory capable of dealing with 30,000 tons of nuts yearly and to begin work within 3 years. The Company also undertakes either to double the capacity of the original factory or to build a second of similar capacity within 30 months after the expiration of the second period. The Government, on the other hand, reduces the export tax to 1 per cent. *ad valorem* on the oil extracted, oil by-products, cattle food, babassu flour, manures, and fuel oil. This export tax will be in force for the first 20 years, after which it will

be increased by 1 per cent. until the expiration of the concession. If the extraction of the oil exceeds 1,000 tons per year within 30 months from the date of the contract the Company will be exempted from the export tax for two years.

Silica Dust as an Insecticide.—Many substances used as insecticides are actual insect-poisons, but various non-poisonous materials in the form of very fine dust have also been tried at different times, their lethal effect being more of a physical nature. In a series of recent trials one of the most promising of these materials was a proprietary silica dust stated to consist of a pure quartz sand, ground to such a degree of fineness that the particles approach colloidal size, and to contain 98 per cent. of silica, with only very small quantities of aluminium, iron, calcium, and magnesium compounds (" Versuche zur Bekämpfung des Kornkäfers mit Staubmitteln" by B. Germar, *Z. Angew. Ent.*, 1936, **22**, 603-630).

The practical trials were made with the granary weevil (*Calandra granaria*). It is believed that the fatal effect of the dust is due to a withdrawal of water from the tissues of the insect, owing to the large increase in body surface caused by the adherent dust. The effect of the dust is consequently dependent upon the fineness of the particles, and their power of adhering closely to the body of the insect, but the age of the insect is also a factor, the younger individuals being definitely more readily susceptible than the older. The temperature and the relative humidity of the atmosphere are also important.

The treated grain should contain 1 per cent. by weight of the dust, which is best applied in the autumn or at the end of the winter, and should, of course, be stored in a dry place. The dust is non-toxic, and is removed by the usual processes preceding milling.

The treatment is said to be effective with regard to the existing weevil population, in retarding oviposition and hence preventing reinfestation, and to be economically practicable from the point of view of cost and ease of application.

The Mineral Resources of Hyderabad.—In Bulletin No. 2 of the Hyderabad Geological Series entitled " A Brief Outline of the Geological History of Hyderabad State with a Reference to its Mineral Resources," K. Mirza summarises, in three sections, the work of previous observers, the geological history of the State, and its mineral resources.

The first systematic survey in the State was undertaken in 1857 by the Geological Survey of India, but it was mainly concerned with those areas of economic importance bordering on the British India Districts. It was not until 1921 that the

Hyderabad Geological Survey was inaugurated. Since then a good deal of survey work has been accomplished, but as this was based upon inaccurate topographical maps the results will not be published until revised sheets are available.

In the west and north-west an area amounting to about half that of the State is occupied by Deccan Trap, about one-eighth is covered by sedimentary rocks of Gondwana and pre-Cambrian age, and the remainder is covered by the great Archæan Complex with subordinate areas of Dharwar schists distributed in them. About 1,150 sq. miles of Dharwars have so far been mapped.

Coal is the most important mineral at present being exploited in Hyderabad, the chief producing areas being those of Singareni, Tandur, and Sasti, but the existence of coal has been proved in many other areas.

Numerous other mineral occurrences have been recorded and there is abundant evidence, in disused workings and slag heaps, of ancient local industries, some of which are still struggling on, for example the production of iron, salt, clays and ochres. Iron ore is widely distributed, but cannot compete in the market with the high-grade ore cheaply obtained in Bihar and Orissa. The fact that no good coking coal has yet been found is another handicap, but surveying continues, and the possibility of using hydro-electric power for some purposes in place of coal has not been lost sight of. Two varieties of salt are produced, one of which is edible and the other used for tanning. Edible salt could be produced in quantities large enough to supply the localities in which it occurs, but this is only a fraction of the requirements of the State. The prospects as far as tanning-salt is concerned are better, and any increased output would always find a ready market. Saltpetre and *dhobies earth* (mainly sodium carbonate) are produced, chiefly for local use.

Gold, diamonds, garnet, copper, and laterite have been worked in the past, and in the case of gold and diamonds it is hoped that recent surveys will encourage fresh interest in them, although gold has already seen one short-lived revival. Mica occurs, probably in economic quantities, and there are large deposits of kaolin, zeolites, and felspar. Building and road stones occur in great variety.

The State contains the raw materials for several industries, such as glass-making, cement-making, and ceramics. The local glass bangle industry has suffered severely from an influx of cheap foreign material, but it is encouraging to note that a glass factory has been established near Hyderabad. Clays of many types are found widely distributed in the State, and with the large quantities of potash felspar available, the possibilities of establishing a ceramic industry are promising.

Fireclays also occur and were used by the indigenous iron smelters.

The limestones and shales from near Sahabad form the raw material for the local cement factory which supplies a large part of the requirements of Southern India, and abundant materials suitable for cement-making are available in the Bhima and Kistna basins.

Occurrences of graphite, galena, ilmenite, kyanite, semi-precious stones, corundum, stibnite, talc, etc., have been recorded, and although manganese is not widespread, certain areas appear to be worthy of special investigation. Big rivers such as the Godavari, Kistna, Tungabhadra, etc., flow through the State, and the economic possibilities of hydro-electric power production are being kept in view as this may be of assistance in any future mineral development.

The Copper Industry of Northern Rhodesia.—A comprehensive review of the copper industry of Northern Rhodesia recently appeared in the *South African Mining and Engineering Journal* (1937, **48**, 245-291), and from this source the following particulars have been taken. It is claimed that Rhodesia owes much to South Africa, whose financial houses provided capital and whose mining industry provided skilled labour for the prospecting and development of the copper mines.

The history of the field, though short, has not been one of continuous success. The deposits on the British side of the Congo border were first discovered by the Grey expedition in 1895 and the ore-bodies of Bwana M'kubwa and Roan Antelope were actually located in 1902. The low-grade ore of which the deposits consist offered no attraction at that time and there were no further developments until 1922, when Bwana M'kubwa again came into prominence. Though this mine subsequently proved disappointing, the Roan Antelope ore-body on the other hand proved on drilling to be a 20-30 ft. bed folded in the form of a trough reaching to a depth of 3,000 ft. Later, the Nkana deposits were found to be of the same form. The huge reserves available in such ore-bodies, together with the suitability of the sulphide ore for flotation separation, immediately placed these mines in the forefront of the copper mining industry of the world. The total proved ore reserves are now said to be 600 million tons, averaging about 4 per cent. of metal. The remarkable consistency of the ore-bodies, both in width and grade, has now made possible the delivery of blister copper from this area in the heart of Africa to world markets at £20 per ton.

At the present time the three producing mines are Roan Antelope, Nkana, and Mufulira. The first to begin production was the Roan Antelope, which commenced milling in June

1931 and smelting in October of that year. Progress was rapid and over 55,000 tons of copper were produced in the year ended June 30, 1934. By the end of 1936 production was at the rate of 67,000 tons a year and the reserves amounted to 95 million tons containing 3·43 per cent. of copper. The building of a smelter on the field at such an early stage in development was of great use to the industry as a whole, for ore from Mufulira was also smelted at the Roan Antelope until the Mufulira smelter was blown in at the beginning of the present year.

The Nkana mine began milling in December 1931 and smelting in March 1937. The rate of output is expected to exceed 100,000 tons a year by the end of 1937. This mine, with its reserves of over 125 million tons of 3·5 per cent. ores, is likely to become the largest producer in the field.

The youngest of the producing mines is Mufulira, which lies near the Congo border, on the southern limb of another trough-like structure. The ore-body, which has been traced along 7,000 ft. of strike, is in places 100 ft. thick, separating elsewhere into three veins. The reserves have been estimated at 160 million tons of 4·1 per cent. ore. Ore was first struck in a borehole in 1928, since when five shafts have been sunk, and a plant capable of producing 75,000 tons of blister copper from 2 million tons of ore a year has been almost completed. This constitutes very rapid development during a period of economic depression. The Roan Antelope smelter produced over 5,000 tons of copper from Mufulira ore in the year ended June 1934, and 28,000 tons in the year ended June 1936; in the same period production costs were reduced from £42 per ton to £30 and a further reduction to £25 is expected shortly.

Another mine now being developed is the Nchanga West, which has 46 million tons of ore averaging 6·9 per cent. copper, including 6 million tons of 17 per cent. ore. Progress here was brought to a standstill in 1931 by an inrush of water, but the shafts are now being cleared and pumping machinery installed. The total reserves of the Nchanga Consolidated Copper Mines Ltd., which owns three other ore-bodies in addition to Nchanga West, amount to nearly 144 million tons averaging 4·6 per cent. of copper, the content of oxidised metal being 2·5 per cent. On the Nchanga West ore-body, however, there is a content of 3 per cent. of copper in the oxidised condition. It is hoped that the "oxides" will be as successfully floated as in the Belgian mines.

The present position of the industry in Northern Rhodesia may be gauged from her smelter capacity of nearly 300,000 tons of blister copper a year and her refinery capacity of 36,500 tons of electrolytic copper a year. In addition there

remain other mines such as Mindola, Chambishi, and Baluba which have yet to be brought into production.

By-Products from the Trail Smelter, Canada.—From a relatively simple mining proposition the operations of the Consolidated Mining and Smelting Company of Canada, Ltd., have grown in twenty-seven years into a vast metallurgical and chemical industry, the earnings of which, from the sales of metals, chemicals, and fertilisers, in 1936 amounted to almost £6 million. The scope of the Company's activities has formed the subject of a recent article (*Canad. Chem. Metall.*, 1937, **21**, 165-169).

The Trail plant, situated at Tadanac, British Columbia, twelve miles from the international boundary, depends for its supplies of ore principally upon the Sullivan mine, where ore was discovered in 1892 and systematic development work commenced in 1900.

The deposits are found in the Aldridge formation as replacements in argillaceous quartzites and reach a thickness of 240 ft. perpendicular to the dip. The ore commonly consists of galena, the marmatite variety of zinc blende, pyrite, and pyrrhotite, an assemblage which restricted mining to the high grade galena strings until a process of selective flotation was evolved which enabled satisfactory lead and zinc concentrates to be prepared.

The refining processes applied both to the lead and to the zinc leached from the sintered concentrates are electrolytic in character, and from the slimes that collect in the lead tanks, where the electrolyte is a mixture of lead silico-fluoride and hydrofluosilicic acid, considerable quantities of copper, gold, silver, and bismuth are obtained. From the zinc residues, by a further electrolytic treatment, cadmium of 99·999 per cent. purity is obtained.

In addition to these metallic products many chemicals and fertilisers are manufactured from the non-metallic constituents of the ore. This aspect of the industry had its origin in the large volumes of sulphur dioxide gas evolved in the sintering plant, which, being given free access to the atmosphere, caused serious damage to vegetation, especially lower down the valley in the United States. The international complications which arose necessitated the installation of a sulphur dioxide recovery plant, and to utilise the product the manufacture of sulphuric acid by catalysis was undertaken, vanadium masses being employed.

The Company, visualising that ultimately the Canadian prairies would require large amounts of fertiliser, and possessing stocks of sulphuric acid, began the manufacture of superphosphates from phosphate rock obtained from the Crow's

Nest Pass district and the Anderson mine near Garrison, Powell County, Montana. The success which attended this venture and the cheap and abundant power available from the Company's subsidiary electrical undertaking, initiated schemes for nitrogen fixation and the subsequent conversion of the ammonia to ammonium sulphate. At present the hydrogen employed in ammonia synthesis is prepared in 934 10,000 amp. cells containing a 25 per cent. potash solution maintained at this strength by a continuous feed of distilled water. Most of the by-product oxygen has hitherto been wasted, but experiments are being conducted with a view to its use in the metallurgical furnaces. The output is about 9 tons of hydrogen and 72 tons of oxygen per day. The nitrogen plant is a standard 2-unit liquid-air producer capable of yielding 44 tons of nitrogen daily.

For the synthesis of ammonia, nitrogen and hydrogen are mixed in the proper ratio and, after purification and compression to 250 atmospheres, are converted to ammonia in four synthesis units each with a capacity of 25 tons a day. Actual production is, however, limited by the capacity of the hydrogen installation to about 48 tons per day. The conversion process has an efficiency of 21 per cent., the residual nitrogen and hydrogen being recirculated with additional gases from the compressors.

Sulphuric acid and phosphate rock are also used in the production of phosphoric acid, which, with ammonia, gives mono-ammonium phosphate. Triple superphosphate is also produced. The latest development has been the reduction of a part of the sulphur dioxide to sulphur, and the purity of the product from the initial 30-ton reduction unit; which in 24 hours has yielded as much as 44 tons of the element, has led to the installation of a second plant.

To meet the seasonal demand for fertilisers large storage capacity is necessary and provisions are made to hold about 70,000 tons.

Some idea of the scale upon which the operations are carried out may be gleaned from the fact that in 1936 the ore treated amounted to 1,737,395 tons, from which were extracted 162,983 tons of lead, 112,227 tons of zinc, 386 tons of copper, 526,034 lb. cadmium, 360,613 lb. bismuth, 8,615,795 oz. silver, and 69,330 oz. gold, while the chemical plants produced 87,046 tons of fertilisers and 3,093 tons of sulphur.

Nyasaland Ilmenite.—In connection with an official survey of the ilmenite resources of Port Herald Hills, samples of ilmenite rubble and ilmenite sand were forwarded in 1935 to the Imperial Institute for analysis and report. The results of these investigations are described in the Annual Report

of the Nyasaland Geological Survey Department for 1936, from which source the following details have been abstracted.

Chemical analyses of two samples of coarse and fine ilmenite rubble obtained from residual surface deposits south-west of Tengani Halt, showed little difference in their composition. The finer material (A), weighing 137 lb., contained fragments mainly up to about 1½ in. in diameter, whilst the coarser material (B), weighing 125 lb., contained fragments up to about 4 in. in diameter. The results of the analyses are shown below.

ANALYSES OF ILMENITE RUBBLE

		A.	B.
		Per cent.	*Per cent.*
Silica	SiO_2	0·62	0·78
Titanium dioxide	TiO_2	45·71	43·76
Ferrous oxide	FeO	34·65	35·60
Ferric oxide	Fe_2O_3	16·06	16·69
Alumina	Al_2O_3	0·20	0·24
Manganous oxide	MnO	0·20	0·20
Chromic oxide	Cr_2O_3	0·24	0·27
Vanadium pentoxide	V_2O_5	0·42	0·43
Uranium oxide	U_3O_8	not detected	not detected
Lime	CaO	not detected	not detected
Magnesia	MgO	1·90	2·03
Moisture (105° C.)	H_2O-	0·11	0·04
Combined water	H_2O+	0·30	0·30
Total		100·41	100·34

In order to ascertain the suitability of the ilmenite for commercial use, a portion of the finer lump material was submitted to a practical small-scale trial by a firm of manufacturers of titanium pigments in Great Britain. The firm reported that although they found some difficulty in getting a good reaction, it is quite possible that with a slight modification of their process a satisfactory pigment could be obtained. They further stated that the ilmenite they now use is in the form of sand, and as the sample submitted was in lump form this would necessitate an extra crushing operation which would add slightly to the relative cost of the pigment.

Samples of ilmenite sand from the Nkande Stream were later submitted to the Imperial Institute for examination, with the following results :—

	A*	B†
	Per cent.	*Per cent.*
Ilmenite	41·9	37·0
TiO_2 content	*50·78*	*48·40*
Magnetite	1·2	0·7
Remainder (largely garnet)	56·9	62·3

* *Sample taken between Ntumba Village and Nyambobo Hill.*
† *Sample taken near Mlaka foothills.*

These sands, which occur in considerable quantity over a distance of some miles along the bed of the Nkande and neighbouring streams, accordingly yield an ilmenite considerably richer in titanium than that from the surface rubble described above.

Wolframite and Scheelite in Southern Rhodesia.—As a result of much prospecting and development work during 1936, a number of tungsten ore mines are now said to be approaching the producing stage in Southern Rhodesia (*Min. Jour.*, 1937, **198**, 641). The most important of these is the R.H.A. mine at T'Shontanda in the Wankie Area, where a plant has been erected for the treatment of 150 tons of wolfram ore per day. Electric power is supplied from the Wankie Colliery and an ample supply of water has been obtained from a series of boreholes. The district, however, is dry and fly-infested, so that large areas round the mine, village and roads have to be cleared of trees. Development of other claims in the same area is held up by lack of water supplies.

A rich body of scheelite has been developed at Bekita, in the Fort Victoria district, and is expected to come into production before the end of the year.

Tinstone has long been known to occur in both these districts, and it is hoped that the opening up of the scheelite mines may give an impetus to the working of these deposits.

At Essexvale, in the Bulawayo district, a number of rich scheelite deposits are known, and already 15 tons of the mineral obtained from the Lo Matchie mine have been disposed of at a good profit. The Sapphire Blue mine is estimated to have a reserve of 48,000 tons of ore, samples of which have been treated at the "Good Enough" gold mill, some miles distant, which is the property of the owners of Sapphire Blue mine. A stamp and two James concentrating tables are being used to produce a scheelite concentrate until a new mill can be erected at the scheelite mine itself.

Briquetting Coal with Sodium Silicate.—A number of substances have been suggested for use as binders in the briquetting of coal, the most commonly used being organic materials such as tar or pitch. These often affect the smoke producing properties of the coal, and where anthracite dust is to be briquetted so as to produce a smokeless fuel, an inorganic binder is to be preferred. The use of sodium silicate for this purpose was patented as long ago as 1866 and other inorganic binders which have been employed include clay, lime, magnesia, and various cements.

The use of sodium silicate alone as a binder produces a briquette which has little resistance to water, and a number of

other substances have been added to increase the wet strength. Another method of treatment is to coat the finished briquettes with a waterproof layer, but this process is expensive and the product obtained has to be handled with care as injury to the surface destroys the protective effect.

F. D. Snell and C. S. Kimball (*Ind. Eng. Chem., Indust. Edn.*, 1937, **29**, 724) have described a binder prepared by dissolving a silicic acid gel in sodium silicate solution. Briquettes made with a mixture of 1 part by weight of this binder, 6 to 10 parts of anthracite dust and up to 3 parts of water were dried at 220° C. for 15 to 20 minutes. The resulting fuel, which is smokeless, has a high mechanical strength and is moderately resistant to water, but very much more so than briquettes made with commercial sodium silicates. The briquettes were used for firing a hot water supply boiler and found to burn freely, giving a soft and fluffy ash with no clinker, a satisfactory draught being maintained. In an open fire they burnt completely with no more smoke than is usually produced with anthracite, leaving a soft grey skeleton of ash, which broke down readily. The silicate binder used is more expensive than tar, costing about $1.60 per ton of briquettes.

Mineral Fuels as Source of Producer Gas for Motor Vehicles.—The possibility of using producer gas made from home-produced solid fuels in place of imported liquid fuels such as petrol and fuel oil for transport purposes continues to attract attention in countries where natural supplies of liquid fuels are deficient. The use of charcoal and wood for this purpose in tropical countries has been considered in this BULLETIN (1932, **30**, 469-479).

The subject has for some time received considerable attention in Germany, and recent advances in this direction have been described by R. Hartner-Seberich ("Motor Gas Producers and Their Fuels: Their State of Development with Special Reference to the Use of Fossil Fuels." *Fuel*, 1937, **16**, 15-27, translated from *Brennstoff. chem.*, 1936, **17**, 1-11). The author gives a comprehensive review of recent developments in the use of charcoal, raw wood, and some solid mineral fuels for gas-producers for various forms of transport, and then goes on to describe his own experiments in the use of solid mineral fuels for this purpose.

There were considered to be two possible methods of approach to the problem; firstly, to carry out the gasification of the fuel at a moderate temperature, avoiding clinker formation as far as possible and using special fuels highly reactive with air and steam. Preliminary trials showed, however, that gasification of coal or of a coal-product was not possible without the formation of clinker, even in the case of the most

highly reactive semi-cokes. In addition, the gas produced was of too poor a quality for use in a motor vehicle.

The second method, that of using a very high temperature for the gasification, was therefore tried, the fuel used being a bituminous coal of low ash content. It was found necessary to add to the coal a small proportion (about 2 or 3 per cent. of its weight) of lime in the form of milk of lime in order to avoid the evolution of sulphur dioxide in the gas. Various modifications in the design of the gas producer and of the purifying and filtering apparatus were made and the conclusion was reached that the high-temperature method of gasification is very promising for the development of a useful producer-gas vehicle using coal of high calorific value but of low reactivity.

Newfoundland Marble.—For many years marble has been known to occur at several places in northern Newfoundland, although very little, if any, has been produced up to the present time. In 1936 interest was focussed on these occurrences, chiefly as a result of the economic sanctions which had been applied against the Italian marble industry, and the Geological Section of the Newfoundland Department of Natural Resources engaged Dr. George W. Bain, of Amherst College, Massachusetts, to make a field survey of the marble areas. The following notes have been taken from Dr. Bain's preliminary report on the Canada Bay and White Bay marble deposits, issued by the Geological Section in August 1936.

In the Marble Bay area blue, grey, cream, and white marble occurs in a zone, less than 1 mile wide, of metamorphosed Palæozoic sediments, lying west of a line through Englee and Canada Harbour. A highly bituminous limestone, apparently suitable for black marble, also occurs at intervals along the east side of Canada Bay from Calcite Point northward.

The white and cream coloured marbles are exposed at Light Point on Englee Island, along the west side of Canada Harbour, and along Marble Ridge, extending from Canada Harbour towards Cat Cove. The beds are usually thin and broken by joints and breccia zones, although one deposit on Marble Ridge, about 1,200 ft. south of Canada Harbour, may prove sound when stripped of debris. At present the principal white marble quarry is on the north end of Marble Ridge, where the following succession of beds, in descending order, has been proved :—

White marble with minor veining and clouding	10 ft.
Heavy green silicate band	1 ft. 4 in.
White marble with some green clouds	7 ft.
Green marble striped white	10 ft.
White marble with heavy green clouding	6 ft.

Blue-grey marble occurs at Burnt Point (west of Canada Harbour) and on Englee Island, about 600 ft. north-east of the bridge, while an occurrence of grey marble has been found about ½ mile north of Bide's Point, on the west side of Bide's Arm.

Marble occurs in the Sops Arm district, White Bay, along a narrow band running west of the Arm for about 1½ miles to Main Brook, and thence northward along Doucer's Brook for approximately the same distance. The zone is bounded by a fault on the west and by slates and quartzites on the east. A coarse reddish granite lies on the west side of the fault and forms a definite easily-distinguishable boundary.

The marble is a breccia similar to many of those quarried in northern Italy. It is very fine grained and varies in colour from grey to white with veins of white calcite and red iron oxides. The marble is brittle and easily fractured.

At the end of Giles Cove Road, near Doucer's Brook, the stone is generally grey and similar to marbles from Tokeen, Alaska, in colour and pattern, but is somewhat darker. At Doucer's Brook the marble has a very fine texture ; it is light coloured and has an orange to red coloured irregular breccia-veining, resembling closely some of the marbles from Lombardy.

In the Gorge locality, near Doucer's Brook, there is a remarkable breccia marble resembling that from Baranoff, Alaska, but up to the present very little of this material has been discovered.

South African "Wonderstone."—A bluish-grey slaty-looking rock, quarried intermittently for many years near the village of Ottosdal in the Western Transvaal, has of late years become known as the "Wonderstone" because of certain qualities regarded as unique. It forms the subject of a detailed *Bulletin* (No. 8) entitled "Wonderstone," prepared jointly by the Geological Survey and the Minerals Research Laboratory, and published recently by the South African Department of Mines. The Bulletin comprises a geological report by L. T. Nel, a description of the properties and possible uses of the stone by H. Jacobs, and a report on its electrical properties by J. T. Allan and G. R. Bozzoli.

The stone occurs as lenses up to about 200 ft. in thickness in volcanic formations, belonging to either the Ventersdorp system or the Dominion Reef series of the Witwatersrand system, to the north and north-east of Ottosdal in the Lichtenburg District. The principal outcrop at Gestoptefontein hill is estimated to be capable of affording 5 million tons of quarryable stone. Joints are rarely so numerous as to interfere with quarrying, which is carried out on the dip slope of the hill (dip 35°) by cutting the rock with a long endless wire

into wedge-shaped sections measuring about 75 by 48 ft. on the horizontal plane and 30 ft. high at one end. Splitting of these blocks is done by driving large chisel-pointed crowbars into bedding joints with 45 lb. sledge hammers.

"Wonderstone," also known as "Ottosdal G stone" and "Koranna stone," is a sedimentary rock consisting of an assemblage of very fine-grained minerals chiefly of a scaly or micaceous habit. Pyrophyllite forms about 89 per cent. of the rock; the remainder consists of approximately 9½ per cent. of a mineral identified as either chloritoid or epidote, and 1½ per cent. of rutile. The chemical composition closely resembles that of the clayey product resulting from the alteration and leaching of a pumiceous ash by percolating solutions when most of the alkalis and some of the silica are removed and water added. The stone appears, therefore, to be a metamorphosed clay—probably bentonite—derived from volcanic ash.

Wonderstone is not so much distinguished by any specific physical property as by the fact that it combines several useful qualities which, it is claimed, render it suitable for a variety of applications.

The stone has a light bluish-grey or slate colour, which remains very uniform through large thicknesses of the rock in all its exposures and does not discolour materially upon prolonged exposure. The texture is very fine-grained and uniform; and the weight of a foot cube is 172 lb. One of the most useful characteristics is that, being softer than the average slate, the rock can be readily sawn, chiselled, drilled, and finely carved with ordinary wood-cutting tools; it can also be turned on a lathe. To obtain a flat smooth surface ordinary planes are employed, the cutting irons of which, it is claimed, wear no quicker than when used on hard wood. Notwithstanding the ease with which it can be worked, the stone has proved in use to be more resistant to abrasion than might have been expected. It wears more evenly, though possibly more quickly, than slate, and is not as slippery when wet.

The resistance of Wonderstone to weathering is particularly marked and is borne out by the fact that ancient petroglyphs carved on flat exposed surfaces of the stone are in many cases still perfectly preserved.

Although the technical tests indicate that Wonderstone is unsuitable for some of the purposes investigated, it still has a useful field of application. As a structural material it is claimed that the stone can be employed for masonry, paving slabs, panels, window sills, tiles, table tops, including billiard tables, etc. For ornamental and similar work it may be used for mantelpieces, tombstones, clock cases, ash trays, etc.

With regard to the possible application of Wonderstone to electrical work the tests show that in the raw state it is suitable for low voltage supports and switchboards. The baked material is more suitable for small parts such as switch toggles, resistance bobbins, heating element supports, fuse carriers, etc., but it is pointed out that considerable care and experience will be required in the mechanical design and baking of such parts.

The South African Ochre Industry.—The ochre deposits of the Riversdale District, Cape Province, are described in detail by D. J. L. Visser in a recent *Bulletin* (No. 9) published by the Geological Survey Division of the South African Department of Mines.

Yellow and red ochres of good quality occur in altered Bokkeveld shale (Devonian) in the south-eastern portion of the Riversdale District, north of the railway to Mossel Bay, about 2 to 10 miles west and north-west of the village of Albertinia, where the material is quarried on a number of farms. The area over which extensive alteration in the Bokkeveld shale has been observed measures roughly 18 miles from east to west and 6 to 8 miles from north to south.

The value of these deposits was first realised about 1922. Small-scale mining followed and gradually extended as the ochre gained favour in English and Continental markets. Operations on an extensive scale, however, did not commence until 1930, when the African Golden Ochre Co. was floated as a result of the interest and intervention of the Golden Valley Ochre & Oxide Co., of Bristol, England. There are now three companies operating about a dozen ochre quarries, and the annual sales have risen from 1,897 short tons in 1932, valued at £6,131, to 5,585 tons in 1936, valued at £21,270. The railway from Cape Town to Mossel Bay serves the area, the most distant quarries being about 5 miles from the nearest siding. The ochre is railed for export either to Mossel Bay (38 miles) or to Cape Town (276 miles). Roads are fair to good and run into all parts of the area.

A capping of surface quartzite up to 6 ft. in thickness usually overlies the clays. This rock is fine grained, and consists of angular quartz grains in a matrix of amorphous silica—a texture characterising the so-called "Findlings Quartzit." Below this come white, cream, or yellowish clays representing weathered Bokkeveld shales and below them the normal Bokkeveld beds of the Cape system.

Good ochre in workable quantities is generally found at depths of not less than 15 ft. from the surface. It occurs in the white or coloured clays in variable amounts, ranging from pockets containing a few handfuls to lenticular bodies yielding

several tons. Within the white aluminous clays the bodies of ochre are sharply defined; where the clays are coloured there is a gradual transition from good ochre to clay, in which case picking becomes the work of an expert. Deposits of red ochre have been opened up at the Sunrise Ochre Mines and at one of Van As' quarries. It occurs within slightly coloured clays associated with yellow ochre, the latter in part surrounding the red. The Riversdale yellow ochres have a fairly uniform golden yellow colour, which is improved by hand picking to remove ochre of inferior quality. The associated red ochres have a brilliant red colour.

The three concerns operating in the field are the African Golden Ochre Co., Sunrise Ochre Mines, and Van As' Ochre Mines (now Warden and Hotchkiss, Ltd.). The methods of mining practised by the various companies are essentially the same. Open quarrying is resorted to, the work being mostly by pick and shovel. First the overburden of soil and surface quartzite is removed to expose the clays, in which trenches are then cut until a body of ochre is struck. The ochre is carefully picked out and followed by cross trenches or short tunnels from the main trenches. As work proceeds to deeper levels the overlying clays are also removed. In this way a rectangular paddock is formed, which gradually grows in length, breadth, and depth.

The ochre as it comes from the quarries is in irregular lumps containing too high a percentage of moisture for immediate shipment. It is therefore spread on large drying floors and exposed to the sun for one to five days according to weather conditions. The dried lumps of ochre pulverise readily.

A small quantity of saline matter is present, and, being hygroscopic, it greatly affects the amount of moisture in the ochre. For export a maximum of 10 per cent. of moisture is allowed by overseas buyers, a penalty of 1 per cent. of the purchase price for every 1 per cent. of moisture in excess of this limit being levied. It is found, however, that, under the usual climatic conditions prevailing in the ochre-producing area, the ferric hydrates in the ochre can undergo a process of dehydration and cause a change of colour in the pigment. The drying process, therefore, has to be carefully controlled.

To the experienced eye the sorting of high-grade from inferior quality ochre or ochre from coloured clay presents no difficulty, but the work is of necessity slow. At the present rate of production hand sorting is the most effective and economical method of grading the ochre at the quarries.

The following table shows the average cost of production,

prices realised, and monthly output of the various companies in 1934.

	Monthly.	Cost of Production, Transport, Shipping.	Price Realised.
African Golden Ochre Co.	1st Grade, 100 tons 2nd Grade, 150 tons	£2 15*s*. per ton* —	£5 10*s*. per ton £3 10*s*. per ton
Sunrise Ochre Mines	1st Grade, 25 tons Red	£1 15*s*. per ton, production only —	£3 per ton £3 10*s*. per ton
Van As' Ochre Mines	" Super," 130 tons	£3 4*s*. per ton†	£7 per ton

* *Shipping at Mossel Bay.* † *Shipping at Cape Town.*

It is impossible to estimate the reserves of ochre in the area owing to the small and often irregular size of the bodies, their scattered occurrence over a large area, and the fact that no clue as to the whereabouts of an ochre body is found at the surface. At the present rate of production, however, all the companies claim to be able to see at least another 25 years' work ahead of them. Supplies of water being insufficient, the possibility of erecting a refining plant close to the quarries is practically ruled out.

Utilisation of Nepheline Syenite in the Glass Industry.—It has been stated in the course of a survey of the Indian glass industry (E. Dixon, *Bul. Ind. Industr. Res.* No. 2, 1936, p. 39) that there is no reason why most of the glass required in India should not be manufactured in that country. At present only small works can run with profit, but this is said to be due to the importing of cheap foreign ware, particularly from Japan, reckless internal competition, a lack of organisation and technical knowledge, and the cost of raw materials, particularly soda-ash. Efforts are now being made to put the Indian glass industry on a sounder footing, and the Benares Hindu University proposes to open a Department of Glass Technology in which the problems of the industry will be studied.

In this connection an account of work carried out by V. S. Dubey and P. N. Agrawala (*Bul. Ind. Industr. Res.*, No. 7, 1937) on the use of nepheline syenite rock as a partial substitute for soda-ash in glass making is of interest. Attempts have been made to utilise this material for glass manufacture in the U.S.S.R., and in Germany rock of similar composition has been employed.

Ample supplies of sand and limestone of the type now being used for glass making are available in India, but the

soda-ash used has to be imported, which naturally increases the cost, whereas large quantities of nepheline syenite occur in India within fairly easy reach of the industrial centres. The rock contains considerable quantities of alumina in addition to its high alkali content, but it has been found elsewhere that glass is improved in quality by the presence of alumina up to about 8 per cent., although a higher furnace temperature than usual is required for its production.

Experimental melts were made in India with nepheline syenite replacing part of the soda-ash of the batch, and it was found that a workable melt, from which bottles could easily be blown, was obtained at 1,200° to 1,250° C. Owing to the presence of ferro-magnesian minerals in the rock the glass obtained was greenish in colour, but it could be used for the manufacture of cheap bottles. In order to obtain colourless glass the minerals containing iron would have to be separated from the crushed rock, as the amount of iron which they introduce into the glass is too high to be neutralised by the use of manganese dioxide.

A sample of the crushed rock, which contained roughly 15 per cent. of hornblende, was treated in a magnetic separator and the purified material was found to contain less than 0·03 per cent. of iron. No melts were made with this purified material, but it was assumed that glass made from it would be practically colourless.

The cost of mining, crushing, and purifying the rock has been worked out, and it is calculated that using a batch composed of sand 100 parts, purified nepheline syenite 100 parts, slaked lime 34 parts, and soda-ash 50 parts, instead of the usual mixture, the cost of production would be reduced from Rs. 1.10.6 per maund of glass to Rs. 1.3.6, thereby reducing the cost of the batch by 30 per cent. and the amount of soda-ash used by 45 per cent.

Other naturally-occurring alkali-containing materials such as felspar and a graphic granite were tried as partial substitutes for soda-ash, but the melt produced at 1,250° C., which was the highest temperature available, was too viscous for satisfactory fining and working.

Use of Rare Earths in Cosmetics.—Among the minor uses of the rare earths is their employment in cosmetics, for which purpose the compounds of cerium, lanthanum, praseodymium, neodymium, and erbium, as well as those of thorium, are of interest. ("Die Seltenen Erden in der Kosmetik," by H. Janistyn. *Deutsche Parfümerie-Zeitung*, 1936, **22**, 165-166).

Cerium salts have tonic and antiseptic properties, a very dilute solution of cerium nitrate having noteworthy bactericidal action. The oxide can form coloured lakes which are used

as nail-polishing powders, an impure cerium oxide containing appreciable quantities of oxides of lanthanum, neodymium, and praseodymium being quite suitable for the purpose.

Lanthanum salts have a bactericidal action and are used in some beauty preparations. The salts of neodymium and praseodymium also possess bactericidal properties, while erbium salts are tonic and astringent.

Thorium salts, which are radioactive, possess little toxicity. They are astringent and tonic, and can cure certain parasitic skin infections. The soluble thorium salts are used in creams and lotions. Thorium oxide forms a white dense powder insoluble in water and in dilute acid, and is used in dental powders and pastes. Thorium compounds, in the form of the stearate or oleate, are also used in creams.

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Estimate of Natural Gas Reserves from the Layton, Oolitic, and Oswego-Prue Horizons in the Oklahoma City Oil Field. By R. E. Heithecker. *Rep. Invest. No.* 3338, *U.S. Bur. Mines.* Pp. 33, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1937.)

Petroleum in the Far East. By A. H. Redfield. *Internat. Petr. Tr., Spec. Suppt.*, 1937, **6**, No. 4, pp. 24.

Inland Exploration Company acquires all Afghanistan for Oil Search. *Petrol. Times*, 1937, **38**, 78-79, 121-122.

Pigments

The Ochre Deposits of the Riversdale District, Cape Province. By D. J. L. Visser. *Geol. Ser. Bull. No.* 9, *Dep. Mines, Union S. Afr.* Pp. 21, 9½ × 6. (Pretoria: Government Printer, 1937.) Price 3*d.*

Potash

Tests of the Compressibility and Bearing Strength of Potash Salt. By H. P. Greenwald and H. C. Howarth. *Tech. Pap. No.* 575, *U.S. Bur. Mines.* Pp. 32, 9 × 6. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1937.) Price 10 cents.

Rock Wool

Rock Wool Plant. By B. Nordberg. *Rock Prod.*, 1937, **40**, No. 5, 66-68. A description of the rock wool plant of Gypsum, Lime and Alabastine, Canada, Ltd.

Salt

India: Report on the Administration of the Salt Department in Orissa during the year 1935-1936. Pp. 10, 13 × 8½. (Cuttack: Government Press, 1936.) Price 6 annas.

The Salt Industry in India. By S. C. Aggarwal. Pp. 294, 9½ × 6¼, and map. (Delhi: Manager of Publications, 1936.) Price Rs. 4-14-0, or 8*s*. 3*d*.

Indian Salt Industry. By K. H. Vakil. Pp. 12, 9½ × 6¼. (Bombay: Okha Salt Works, 1936.)

Evaporating Salt from the World's largest Mineral Deposit. By J. C. Buchen. *Min. and Metall.*, 1937, **18**, 335-338. The production of salt by evaporation at the Leslie Salt Co., San Francisco.

Soda

Magadi Soda Ash: Notes on its Origin, Composition and Principal Uses. Pp. 12, 9½ × 6. (London: Magadi Soda Co., Ltd., 1937.)

Sulphur

Fixation of Sulphur from Smelter Smoke. *Rep. Invest. No.* 3339, *U.S. Bur. Mines.* Pp. 51, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1937.)

NOTICES OF RECENT LITERATURE

Books for review should be addressed to " The Editor," Bulletin of the Imperial Institute, South Kensington, London, S.W.7.

ECONOMIC BOTANY. A TEXTBOOK OF USEFUL PLANTS AND PLANT PRODUCTS. By Albert F. Hill. Pp. x + 592, 9 × 6. (New York: McGraw-Hill Book Company, Inc.; London: McGraw-Hill Publishing Co., Ltd., 1937.) Price 24*s*.

This book is primarily a reference work, containing brief descriptions of plant products of economic importance and the plants which yield them, attention being given especially to those of American origin. The treatment is mainly from the economic standpoint, as the author has intentionally avoided too detailed a reference to the botanical and agricultural aspects of the subject. This treatment has the advantage of presenting no technical difficulties to the reader, but at the same time it detracts from the value of the book as a reference work.

After a short introductory chapter giving the botanical information necessary for a proper understanding of the main text, the descriptions follow immediately. The plants and plant products listed are grouped under four main headings. The first, namely, " Industrial Plants and Plant Products," includes fibres, forest products, rubbers, essential oils and

fatty oils, sugars, starches, cellulose products, and other items. The second deals with drug plants and drugs, the third, food plants, and the fourth, food adjuncts, such as spices and beverages.

There is an appendix containing a systematic list of the species discussed, seven pages of bibliography, and a good index.

THE BIOCHEMISTRY OF CELLULOSE, THE POLYURONIDES, LIGNIN, ETC. By A. G. Norman, Ph.D., D.Sc. Pp. viii + 232, $9\frac{1}{4} \times 6$. (Oxford : The Clarendon Press ; London : Humphrey Milford, 1937.) Price 15*s*.

This work deals with the biochemistry of plant cell-wall compounds and chemically related substances, such as plant gums, seed mucilages and gelatinous carbohydrates from marine algæ and bacteria. During recent years much progress has been made in this field of research, and the materials examined are of great technical importance. The purpose of this book, in the words of the author, is " to examine the present position as a whole, in order that the achievements may be appreciated, and the fields yet to be won surveyed."

The book commences with a general discussion on the occurrence and isolation of cellulose. The author differentiates between " true " cellulose represented by cotton cellulose, which is pure glucose polysaccharide $(C_6H_{10}O_5)n$, and the other polysaccharides associated with it in the natural cellulosic aggregate of the plant cell-wall. For the latter the term cellulosan is proposed. The author mentions that the previously-accepted theory of the existence of compound celluloses such as lignocellulose, pectocellulose, and cutocellulose is no longer compatible with the modern conception of the steric structure of cellulose which does not admit of its combination in the true chemical sense with any other constituent.

The constitution of cellulose is discussed, with the reactions which have led to the adoption of the formula for it now generally accepted. The physical and chemical properties of cellulose are dealt with at some length, and the various methods which have been suggested for the determination and preparation of natural celluloses. According to the author the cellulosan content of many natural celluloses, which consist only partially of true cellulose, is apparently about 20 per cent., and rarely above 30 per cent., and that xylan, the amount of which he has estimated in a number of commercial fibres and woods, appears to be the most commonly occurring cellulosan.

Other sections deal with the extraction and hydrolysis of cellulosans and the biological decomposition of cellulose. Hemicelluloses the author defines as those cell-wall poly-

saccharides which may be extracted from plant tissues by treatment with dilute alkalis, either cold or hot, but not with water, and which may be hydrolysed to constituent sugar and sugar-acid units by boiling with hot dilute mineral acids. Details of the preparation and fractionation of polyuronide hemicelluloses from a number of materials is given and their constitution and classification disclosed, also the preparation and classification of polyose hemicelluloses—pentosans, hexosans, and hexopentosans.

There then follows an instructive chapter on pectic substances in which a review is given of the work which has contributed towards the elucidation of the constitution of pectin, and a study made of the conditions for obtaining pectin-sugar-acid jellies, and the principles underlying this phenomenon. Gums, which are plant exudations more or less soluble in water, are defined as polyuronides in which the carboxyl groups of the uronic acid are free for normal salt formation, differing in this way from the hemicelluloses. The composition and structure of the more common gums are deduced from the study of the products resulting from their hydrolysis. The properties and nature of plant mucilages and other gel-forming substances, such as those of marine algæ, are also described and their distinction from plant gums pointed out.

In a further chapter the nature, properties, and uses of lignin are discussed, and the various theories which have been put forward concerning its constitution. The methods devised for the isolation of lignin and its determination are critically examined. Two chapters deal with the metabolism of plant cell-wall constituents and microbial polysaccharides. An appendix to the book gives a summary of recent work on the characteristic structure of uronic acids, and more especially of the three naturally occurring uronic acids—*d*-glucuronic acid, *d*-galacturonic acid, and *d*-mannuronic acid.

As stated in the foreword by Sir E. J. Russell, the author has rendered useful service by bringing together in one volume the more important of the results obtained of the recent work on this complex group of substances, and has presented them in such a form that they can be understood by any one with an elementary knowledge of organic chemistry.

Forest Insects. A Textbook for the Use of Students in Forest Schools, Colleges, and Universities, and for Forest Workers. By R. W. Doane, E. C. Van Dyke, W. J. Chamberlin and H. E. Burke. Pp. xii + 463, 9 × 6. (London: McGraw-Hill Publishing Co., Ltd., 1936.) Price 25*s*.

In this book the scattered information on forest insects and on the methods of controlling them is brought together

in a general account. It is clearly impossible to cover the field in detail within the limits of a single volume, but this difficulty has to some extent been met by the method of treatment which the authors have adopted, namely, that of dealing at some length with selected examples of insect-types, while other similar types are dismissed briefly. Of necessity most of the insects which are of no economic importance have been omitted.

In the first three chapters problems of forest entomology are surveyed, and the possible methods of insect control available are discussed in general terms. There follows a detailed chapter on bark-beetle control and then a systematic account of forest insects. This latter forms the bulk of the book, and includes three chapters on beetles, one on moths and butterflies, one on termites, and three more on the remaining groups of insects, among which the mites also have been treated. The text is well illustrated with numerous photographs and large-scale drawings, which should be of great assistance in identification. One small point of criticism may be raised in suggesting that unwieldy English names derived from a literal translation of the Latin specific epithet, such as the twice-stabbed or five-maculated lady beetle (which should be fifteen), would have been better omitted.

The value of the work as a background for further study is greatly enhanced by the extensive bibliography given at the end of each chapter, while for reference purposes the appended lists of coniferous and hardwood trees with some of their principal insect enemies, and the detailed index, should prove extremely useful.

FIELD TESTS FOR MINERALS. By E. H. Davison, B.Sc., F.G.S. Pp. viii + 60, $8\frac{3}{4} \times 5\frac{1}{2}$. (London: Chapman & Hall, Ltd., 1937.) Price 7*s*. 6*d*.

The author has attempted in this book to compile a series of physical and chemical tests easily performed in the field with simple equipment, which should enable prospectors and field geologists to identify most of the commoner minerals. The title, however, does not exactly describe the subject matter, which is much more applicable to work in the laboratory than in the field.

The book is in two parts, the first being largely taken up by a detailed account of the various blow-pipe tests for minerals, but includes organic " spot " and microchemical tests which are, however, generally of too sensitive a character to afford useful field results, besides involving the use of reagents which it would be impracticable to obtain, carry and keep in many countries overseas. As an example, the following test for

aluminium (p. 15) is typical: "Fuse the mineral with soda, dissolve in dilute hydrochloric acid adding ammonium acetate. Make a 0·1 per cent. solution of aurine-tricarboxylic acid in water. Mix drops of the two solutions on the porcelain plate. Make alkaline with ammonia. A bright red colour indicates aluminium."

The second and larger part of the book, in addition to discussing physical characteristics such as hardness, specific gravity, cleavage, crystal form and structure, contains twelve excellent plates and an extensive series of determinative tables for minerals, based on hardness, lustre and streak. A subject index is included.

STEELS FOR THE USER. By R. T. Rolfe, F.I.C. Pp. ix + 280, 8¾ × 5¾. (London: Chapman & Hall, Ltd., 1937.) Price 21*s.*

This book, based on a series of articles which appeared in *The Iron and Steel Industry* during the years 1934 to 1937, is an attempt to bridge the gap between science and practice in the utilization of carbon steels in industry. Alloy steels are not specifically dealt with, although they are frequently discussed in cases where carbon steels do not satisfactorily perform the duty.

The book is a practical one, scientifically explained, rather than a theoretical one with practical examples, and includes the results of much mechanical testing carried out in an important engineering works laboratory. As its title implies the volume is intended as a guide to the engineer in the choice and heat treatment of steels.

DAS GALLIUM. By Dr. Rer. Nat. Erich Einecke. Pp. 155, 9¼ × 6¼. (Leipzig: Verlag von Leopold Voss, 1937.) Price RM. 12.

This book is a comprehensive survey of the present state of knowledge of the rare metal gallium in all its aspects. It commences with a brief history of the prediction of the element by the famous Russian chemist, Mendelejeff (which he called eka-aluminium), and its subsequent discovery by Lecoq de Boisbaudron, who renamed the element gallium. In the following chapter on the occurrence of the element, its close association with aluminium, zinc and iron is discussed, and the richest gallium mineral, germanite, which contains 0·5 to 0·7 per cent. of gallium, is described. In the account of the extraction of the metal from various materials and its purification, the German plant at Leopoldshall receives special attention.

A description, illustrated by numerous diagrams, of the

physical properties of the metal and a number of its alloys, together with a section on the inorganic and organo-metallic compounds of gallium, forms the major portion of the publication. The analytical determination of the element, its pharmaceutical and catalytic properties, its atomic dimensions and relations with other elements in the periodic table, are followed by a description of the various applications of the metal in thermometry, medicine, dentistry, and the manufacture of metallic vapour lamps, optical mirrors, and electron tubes. The book concludes with an extensive bibliography of almost 500 references, which are arranged chronologically from 1869 to 1937, and with author and subject indexes.

The author is to be congratulated on the thoroughness with which he has prepared this monograph, which forms a very useful addition to the literature on this rare element.

COMBUSTION APPLIANCE MAKERS' ASSOCIATION (SOLID FUEL). FIRST ANNUAL CONFERENCE, 16TH MARCH, 1937. Pp. 104, $9\frac{3}{4} \times 8$. (London: Offices of the Association, 54 Victoria Street, S.W.1.) Price 2*s*. 6*d*.

Three interesting papers and a record of the lengthy discussions to which they gave rise, are included in this report of the C.A.M.A's. first annual conference.

Reference is made in the first paper, by the Director of the Association, to the empirical factors which determine the performance of fuels under actual working conditions, and to the fact that combustion characteristics cannot be completely defined by small-scale tests, but must take cognisance of individual combustion appliances. To this end, it is stressed that coal producers in a time of rising prices should assist consumers by practical research on combustion problems to be carried out in the factory of the appliance maker as well as in specially-equipped laboratories. It is estimated that to carry out a programme of research comparable with that done by the large oil companies, some £500,000 a year would be required.

The second paper is devoted to the subject of the domestic market for solid fuels. This is one of the most lucrative outlets for coal in the country and accounts for 20 to 25 million tons of coal and 4 million tons of coke each year, but the rapid growth in the use of electricity and gas for domestic purposes is having a serious effect upon coal and coke sales. To combat this, it is said that improvement in the design, sales and service of domestic solid-fuel appliances must be seriously considered, so as to mitigate the troublesome operations commonly unavoidable in purchasing, installing and running such apparatus.

The disadvantages of solid fuel are all summed up in the one word "trouble," but they are definitely offset by low cost, and other advantages in health and comfort. An interesting table is given on p. 27 of the report in which the relative costs of electricity, gas, oil, anthracite, coke and coal are compared. The costs on a thermal basis are in the order given above, electricity at ½*d*. per unit being relatively almost three times as expensive as coal costing 50*s*. per ton. Advantages in health and comfort are, however, very much less tangible, and the compensation of infra-red radiation (p. 28) is a doubtful one. When an open coal fire is used there is 70 or 80 per cent. heat loss *via* the chimney, representing 40*s*. out of every 50*s*. paid per ton of coal.

The difficulties of establishing a good case for coal in the face of serious service deficiencies, atmospheric pollution and the excessive labour such fuel entails in open grates, are patent in this paper.

Recent advances in mechanical firing for steam generation form the subject of the third paper, which describes the developments in gravity feeds, screw underfeeds, travelling grate devices, and in pulverised fuel apparatus. It is pointed out that marine mechanical firing has not shown progress comparable with that made on land, but this is not surprising in the face of the preference shown by many shipowners for oil-fired vessels.

SILICATE ANALYSIS. By A. W. Groves, D.Sc., Ph.D., D.I.C., F.G.S., with a Foreword by Professor A. Holmes, D.Sc., A.R.C.S., D.I.C., F.G.S. Pp. xxi + 230, 8¾ × 5¾. (London: Thomas Murby & Co., 1937.) Price 12*s*. 6*d*.

It is many years since a new book on silicate analysis, in English, made its appearance, and this newcomer, embodying descriptions of duly accredited methods, both old and new, and of the latest modifications in technique, is particularly welcome at a time when the tendency on every hand is to stipulate the determination of more constituents than formerly and to demand greater accuracy.

Silicate analysis is a subject of interest to chemists and geologists alike, and the author has combined the needs of both in this volume. It includes sufficient mineralogy and petrology to satisfy the requirements of the chemist in the course of his work on natural silicates, and the geologist who has had some training in analytical chemistry will find instruction adequate to enable him to undertake the analysis of rocks and rock-forming minerals.

In addition to a comprehensive, yet concise, account of analytical procedure for the determination of over thirty constituents, there are chapters on sampling and crushing,

constituents to be determined, location of errors, limits of error, search for further constituents when there is a deficiency, and notes on the analysis of the principal silicates used as raw materials in industry, on dust, and mineral residues from silicotic lungs. Special methods are given for use when material is scanty.

A chapter devoted to the methods employed by the geologist for assessing the accuracy of chemical analyses of rocks and minerals will be of special value to all who have to deal with such analyses. Another contains a valuable summary of the widely scattered data concerning the geochemical distribution of the elements, a knowledge of which should be acquired by all chemists engaged in the analysis of rocks and other natural silicates. This summary is the first of its kind to appear in English, and should prove a revelation to those who have not followed the recent geochemical literature of other countries.

The volume is bound in a material which has been found to stand up well to laboratory conditions, and its practical value is also enhanced by the printing of instructions for analytical procedure in heavy type. Some analysts may regret that more alternative methods have not been described; nevertheless, credit must be given to the author for a praiseworthy effort to keep down the size and price of the book by presenting only those procedures which he has found to be most satisfactory. The author is to be congratulated on the production of an extremely useful text-book, which combines in an interesting way both practical methods for the analysis of silicate rocks and allied substances, and the theoretical considerations necessary for the interpretation of the results.

BOOKS RECEIVED FOR NOTICE

A Note Book of Tropical Agriculture. Compiled by R. Cecil Wood, M.A. Second Edition. Pp. 147, $6\frac{1}{2} \times 4\frac{1}{4}$. (Trinidad: The Imperial College of Tropical Agriculture, 1937.) Price 5*s*.

Overseas Plant Products. By J. H. Holland. Pp. vii + 279, $7\frac{1}{4} \times 4\frac{3}{4}$. (London: John Bale, Sons & Curnow, Ltd., 1937.) Price 6*s*.

The Journal of the South-eastern Agricultural College, No. 40, 1937. Edited for the College by S. Graham Brade-Birks, M.Sc., D.Sc., F.Z.S. Pp. 188, $10\frac{1}{2} \times 7\frac{1}{4}$. (Wye, Kent: Agricultural College, 1937.) Price 7*s*., post free; to residents in Kent and Surrey, 4*s*., post free.

SOVIET GEOGRAPHY. The New Industrial and Economic Distributions of the U.S.S.R. By N. Mikhaylov, translated from the Russian by Natalie Rothstein. Second Edition. Pp. xviii + 229, $8\frac{1}{2} \times 5\frac{1}{2}$. (London: Methuen & Co., Ltd., 1937.) Price 10*s*. 6*d*.

THE CYCLE OF WEATHERING. By B. B. Polynov, D.Sc., translated from the Russian by A. Muir. Pp. xii + 220, $8\frac{1}{2} \times 5\frac{1}{2}$. (London: Thomas Murby & Co., 1937.) Price 10*s*. 6*d*.

CHEMISTRY OF FOOD AND NUTRITION. By Henry C. Sherman, Ph.D., Sc.D. Pp. x + 640, $7\frac{3}{4} \times 5\frac{1}{4}$. Fifth Edition, completely rewritten. (New York: The Macmillan Company; London: Macmillan & Co., Ltd., 1937.) Price 12*s*. 6*d*.

FOOD TECHNOLOGY. By Samuel C. Prescott, Sc.D., and Bernard E. Proctor, Ph.D. Pp. ix + 630, 9×6. (London: McGraw-Hill Publishing Company, Ltd., 1937.) Price 30*s*.

CACAO FERMENTATION. A Critical Survey of its Scientific Aspects. By Arthur W. Knapp, M.Sc., F.I.C., M.I.Chem.E. Pp. xii + 171, $8\frac{3}{4} \times 5\frac{3}{4}$. (London: John Bale, Sons & Curnow, Ltd., 1937.) Price 10*s*.

ENZYME CHEMISTRY. By Henry Tauber, Ph.D. Pp. xii + 243, 9×6. (New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd., 1937.) Price 15*s*.

THE PESTS OF FRUITS AND HOPS. By A. M. Massee, D.Sc., F.R.E.S. Pp. 294, $8\frac{1}{2} \times 5\frac{1}{2}$. (London: Crosby Lockwood & Son, Ltd., 1937.) Price 15*s*.

COTTON PROGRESS IN BRAZIL. By N. S. Pearse. Pp. xvi + 183, $9\frac{1}{2} \times 5\frac{3}{4}$. (Manchester: International Federation of Master Cotton Spinners' and Manufacturers' Associations, 1937.)

THE RATIONALISATION AND CONSERVATION OF THE TIMBER RESOURCES OF THE WORLD. By A. Harold Unwin, O.B.E., D.Oec. Pp. 48, $8\frac{1}{2} \times 5\frac{1}{2}$. (London: The Technical Press, Ltd., 1937.) Price 2*s*. 6*d*.

GURJUN, APITONG, KERUING, KAPUR, AND ALLIED TIMBERS. By S. H. Clarke, M.Sc. Department of Scientific and Industrial Research, Forest Products Research Records, No. 16 (Timber Series No. 5). Pp. 11, 9½ × 6. (London : His Majesty's Stationery Office, 1937.) Price 6*d*.

THE GROWTH AND STRUCTURE OF WOOD. By B. J. Rendle, B.Sc., A.R.C.S. Department of Scientific and Industrial Research, Forest Products Research Records No. 21. Pp. iii + 24, 9½ × 6. (London : His Majesty's Stationery Office, 1937.) Price 6*d*.

REAGENT CHEMICALS AND STANDARDS. By Joseph Rosin. Pp. ix + 530, 9 × 6. (London : Chapman & Hall, Ltd., 1937.) Price 30*s*.

ECOLOGICAL ANIMAL GEOGRAPHY. An authorised, rewritten edition based on *Tiergeographie auf oekologischer Grundlage* by Richard Hesse, prepared by W. C. Allee and Karl P. Schmidt. Pp. xiv + 597, 9 × 6. (New York : John Wiley & Sons, Inc. ; London : Chapman & Hall, Ltd., 1937.) Price 30*s*.

GOLD DEPOSITS OF THE WORLD. With a Section on Prospecting. By W. H. Emmons. Pp. vii + 562, 9 × 6. (London : McGraw-Hill Publishing Co., Ltd., 1937.) Price 36*s*.

LES RESSOURCES MINÉRALES DE LA FRANCE D'OUTRE-MER. V. Le Petrole. Pp. 263, 9½ × 6¼. (Paris : Société d'Editions Géographiques, Maritimes et Coloniales, 1937.) Price 45 francs.

THE ANALYTICAL CHEMISTRY OF TANTALUM AND NIOBIUM. By W. R. Schoeller, Ph.D. Pp. xvi + 198, 8½ × 5½. (London : Chapman & Hall, Ltd., 1937.) Price 21*s*.

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REPORTS OF RECENT INVESTIGATIONS AT THE IMPERIAL INSTITUTE

Selected from the Reports made to the Dominion, Indian, and Colonial Governments

SUNN HEMP FROM AFRICA

THE fibre known in India as Sunn or Sann hemp, and in Europe also as Indian or Bombay hemp, is the product of *Crotalaria juncea*, a shrubby annual, belonging to the natural order Leguminosæ. The plant is grown throughout India for its fibre, which is widely used locally, and also, like other leguminous plants, as a soil improver. The fibre, the better grades of which are suitable for use as a substitute for Russian hemp, has long been known in Europe, but its use there has been relatively restricted. The opinion appears to be held in the trade that Sunn hemp is inferior to Russian hemp in its resistance to water, but the results of experiments on twines and ropes carried out by the Imperial Institute affords evidence that this view is inaccurate (see " Indian, Sunn or Sann Hemp," a memorandum prepared by the Imperial Institute and issued by the Empire Marketing Board, E.M.B. 25, 1930, pp. 38-40 ; and this BULLETIN, 1931, **29**, 1-31). A full account of the cultivation and preparation of the fibre and of the grades exported, with proposals for improving the quality of the Indian product, will be found in the Memorandum referred to above.

The only other country in which Sunn hemp is produced

on any scale is Ceylon, where in the Jaffna Peninsula the plant has long been established as a fibre crop. The hemp is used there for making fishing nets, and the local fishermen regard the Jaffna product as superior to that from India, which is only purchased when the former is scarce. The whole of the Ceylon product appears to be consumed locally.

The Sunn hemp plant has been introduced into many other parts of the Empire, particularly the African Colonies. Here, however, it is grown mainly as a green manure. In Southern Rhodesia, for example, in 1935, out of a total area of 48,112 acres under green manure crops, 32,532 acres were planted with Sunn hemp. In most of these countries attempts have been made to prepare the fibre, but with varying success. There seems to have been little difficulty in growing the crop, but in some instances lack of experience in retting the stalks and separating the fibre has resulted in a product of poor quality. This was the case, for example, with samples received at the Imperial Institute from Sierra Leone in 1931 and in 1932, and from Southern Rhodesia in 1936.

Amongst the more successful experiments reference may be made to those carried out by the Uganda Department of Agriculture at the Serere Experiment Station (see this BULLETIN, 1931, **29**, 472 ; 1932, **30**, 219 ; 1933, **31**, 264). A series of 26 samples of fibre prepared in different ways in the course of these experiments was examined at the Imperial Institute in 1932 (*loc. cit.*, 1933, **31**, 139). The results were quite promising, although there was still much room for improvement in quality as compared with the better grades of the Indian product. Two further samples prepared by chemical treatment were examined in 1934, and these proved on the whole to be superior to the water-retted samples of the earlier series, and fibre of similar quality should fetch good prices if available in commercial quantities. The full report on these samples is given on pp. 421-422.

In Nyasaland excellent samples of fibre have been produced at the Makwapala Experiment Station of the Empire Cotton Growing Corporation, where Sunn hemp was grown for a few years in cotton rotation trials (*Reports on Experiment Stations, E.C.G.C.*, 1925-26, p. 171 ; 1926-27, p. 195). The yield of fibre there was estimated to be at the rate of 1,000 lb. per acre.

Sunn hemp of promising quality has also been produced in

the Anglo-Egyptian Sudan, and a small consignment of the fibre was recently sent to the Imperial Institute for examination. As will be seen from the report printed below (pp. 422-424), consignments of similar fibre would be quite acceptable to spinners in this country provided the material was of uniform quality and due care was taken in its packing.

I. Samples from Uganda

The two samples of Sunn hemp which are the subject of this report were forwarded to the Imperial Institute by the Director of Agriculture in August, 1934.

It was stated that the Department's Chemist had been attempting to devise a chemical process for the extraction of Sunn hemp fibre and that the samples submitted had been prepared by him as follows :

Sample A.—Prepared from 100 stems. Stems stripped and the ribbons digested with 1 per cent. ammonia and sodium sulphite.

Sample B.—Prepared from 200 stems. Stems digested with water under pressure, then stripped. The ribbons were digested as in Sample A.

It was desired that the samples should be examined in comparison with a series of 26 samples, prepared by various methods, previously submitted to the Imperial Institute (see this Bulletin, 1933, **31**, 139).

The samples were as follows :

Sample A.—This consisted of very clean, well-separated, fairly soft, fine fibre of pale yellowish-brown colour and fair lustre ; portions of the sample, however, were somewhat coarse and gummy towards the butt ends. The strands varied in length from about 2 to 4 ft., being mostly from 2½ to 3½ ft. The strength was on the whole good.

Sample B.—This consisted of clean but imperfectly separated fibre. It was composed of narrow ribbons of rather fine, matted fibre, the butt ends of which were hard and gummy, and it seems probable that there would be considerable loss in combing such material. The fibre was generally of pale greyish-green colour and fairly good lustre, but was slightly harsh to the touch. The length varied from 2 to 3½ ft., being mostly between 2½ and 3 ft. The strength was variable, but on the whole good.

In comparison with the series of 26 water-retted samples previously examined, sample A was much superior in colour (the earlier materials were generally greyish-brown) and was rather softer and better separated; it was, however, not so lustrous as some of the samples included in the series.

Sample B, on the other hand, was similar in colour and character to those previously examined, and bore a close resemblance to No. 8 of the series, which represented a 50-lb. seed rate, 108 days' growth, and had been stripped wet after 5 days' retting.

The samples were submitted to the firm of merchants in London (Messrs. Wigglesworth & Co., Ltd.) who valued the previous series. They furnished the following report:

"*Sample A*.—This is a light-coloured material, of average length, cleaner, softer, and better prepared than Dewghuddy, which it resembles, and we should value it at about £22 per ton. We believe it would be quite saleable in substantial quantities.

"*Sample B*.—This resembles the Madras type of Sunn—between that and Itarsi. The colour is dingy, greyish-green; strength satisfactory; cleaning is right; but the fibre is rather matted. We should assess this at about £18 per ton.

"These values compare with Fine Dewghuddy at £22, Sewnee at £18, and Jubblepore at £17" (November 1934).

It will be observed that the present samples, prepared by chemical treatment, were, on the whole, superior to the water-retted samples examined earlier, and that such fibre should realise good prices.

In this connection it is noteworthy that at the date of the merchants' valuation the market prices of Indian Sunn hemps were practically the same as at the time of the earlier report. The best of the water-retted samples then examined (Nos. 5, 8, 10, 17) were valued at about £16 per ton, whereas the present materials were considered to be worth respectively £6 and £2 in advance of this, Sample A being regarded as equal to Fine Dewghuddy.

II. Sample from the Anglo-Egyptian Sudan

This sample was forwarded to the Imperial Institute by the Director of the Department of Economics and Trade in June 1937. The material represented retted fibre from plants grown in the Equatorial Province.

The sample weighed 2¾ cwts., and consisted of fibre which on the whole was well prepared and from 4 to 4½ ft. in length, although a small amount of shorter material was present. The fibre had been tied up into small bundles, a few of which were in a rather matted condition, and these contained some very short and broken fibre.

The fibre was mostly fairly lustrous and of pale cream colour, but a small proportion was rather darker.

The fibre was chemically examined with the following results:

	Per cent.
Moisture	9·0
Expressed on the moisture-free material—	
α Hydrolysis, loss	6·4
β-Hydrolysis, loss	14·9
Water-washing, loss	1·4
Cellulose	89·2
Ash	0·3

These results confirm the satisfactory preparation of the sample, the figures for water-washing loss and ash being low and the cellulose content very satisfactory.

The fibre was submitted to a firm of rope manufacturers, who described it as of mixed quality, but better than a sample of Sudan Sunn hemp which they had previously inspected. They reported that it was soft, well retted, of good length, clean and straight, and almost equal in colour to No. 1 Bengal Sunn.

The manufacturers carried out spinning tests with the material, and found it to draw well on the frames and to spin satisfactorily. They made from it yarns, lines and twines, which they submitted to tensile tests, with the following results:

	Breaking Strain. *lb.*
1-lea Yarn	55 to 60
2-lea ,,	25 to 30
2801. 1/3 Tent Line T.G.32 Patt. C. 1594	685
1601. 1/3 ,, ,, ,, ,, C. 1595	410
301 Twine in cross wound cheeses	170 to 180
301 ,, balls	170 to 180
302 ,, cross wound cheeses	70 to 80
302 ,, balls	70 to 80

As a result of these tests, and the general character of the sample, the manufacturers considered that, if adequate care were taken in the packing, commercial shipments of fibre of the quality of that under report should be very acceptable to

spinners in the United Kingdom, and that if the satisfactory colour could be maintained the material should compete with No. 1 Bengal Sunn hemp, which was currently realising £25-£26 per ton in London (October 1937). As regards packing, they stated that larger heads should be made up than those in the present sample, and that there was no need to tie them individually as in this instance, but that it would be sufficient to wind a wisp of fibre round them which would keep them together for packing. Small heads, tightly knotted at the top as in the sample, would involve considerable extra labour in opening the bales at the spinners' works.

From the results of this investigation it would appear that if the price likely to be obtainable for commercial shipments would be remunerative, the cultivation of Sunn hemp in the Equatorial Province might be extended with a view to the export of large and regular consignments.

It was pointed out to the Sudan authorities that if the best value is to be realised every attempt should be made to ensure good and regular colour and preparation, and suitable modes of tying and packing for shipment. Emphasis was also laid on the fact that Sunn hemp from the Sudan would always have to compete with the Indian grades already coming to this market, so that every effort would have to be made to produce fibre of the highest quality, and to sort the material into different grades, the portions of inferior character being shipped separately as lower qualities for which correspondingly reduced prices could be accepted.

CASCARA BARK FROM KENYA

HITHERTO the cascara bark used in this country has come entirely from the Pacific Coast of North America. Some of it is produced in the southern part of British Columbia, but this is sent over the border into the United States to be shipped from Californian ports. The only other Empire country which has grown the bark is Kenya. As was stated in a report on a sample of bark from that Colony, printed in this BULLETIN, 1926, **24**, 664, the experimental cultivation of the cascara tree (*Rhamnus Purshianus*) was started by the Forestry Department in 1919. Since then the cultivation of the tree has been

taken up by planters, and according to information received this year for the Director of Agriculture, one or two planters in the Trans Nzoia district are already exporting the bark and are highly satisfied with the results.

A sample of the bark was received at the Imperial Institute from a planter in June 1936, and although rather thin in character, as might be expected of the product of young trees, its quality gave great promise.

A further sample grown by a planter at Njoro, at an altitude of 7,100 ft. was forwarded by the Director of Agriculture in January 1937. The report on the material which was furnished to the Department was as follows:

The sample consisted of narrow quills, about 8 in. long, of very thin bark under 1 mm. thick. The bark was externally greyish-brown to reddish-brown, and the inner surface was reddish-brown.

The bark was examined with the following results, which are shown in comparison with the corresponding figures obtained for samples of cascara bark from Kenya previously examined at the Imperial Institute and with the requirements of the British Pharmacopœia (1932):

	Present Sample.	Previous Samples from Kenya.	Requirements of the British Pharmacopœia. (1932)
	Per cent.	*Per cent.*	*Per cent.*
Moisture	8·5	7·8-9·5	—
Ash	6·5	4·7-7·6	not more than 6
Aqueous extract	26·6	25·3-27·2	—

According to the British Pharmaceutical Codex (1934), cascara bark should yield from 23 to 28 per cent. of extractive. The present sample furnished a satisfactory amount of extractive matter, but the amount of ash was rather higher than that specified by the British Pharmacopœia.

In connection with these results it must be borne in mind (*a*) that it is not possible to assess the quality of cascara bark from an analysis alone, a clinical test of the extract being the only method of practical value, and (*b*) that the bark must be at least one year old before use, as otherwise the extract made from it is likely to act as an emetic. It should be noted in this connection that importers in the United Kingdom usually buy the new bark, and mature it in their warehouses before sale to the manufacturers.

The material was submitted to (*a*) merchants which had examined a previous sample from Kenya on behalf of the Imperial Institute, and (*b*) manufacturing druggists in London, which furnished the following observations respectively :—

(*a*) " The sample shows a similar thin papery quill to that received from you in June of last year, also emanating from Kenya. The result of your analysis shows a satisfactory aqueous extract, and we feel fairly confident that some of our large buyers would be willing to use this commodity if the price is attractive.

" Since we wrote you last year the market for this bark has undergone quite a change—favourable to shippers—and we should be glad to be put in touch with them, as we are now rapidly approaching the time when we shall be receiving offers of new peel from the Pacific Coast for May/June and June/July shipment.

" After opening last season at around 8½ cents c.i.f. European ports—at that time about 38*s*. per cwt.—the price of cascara gradually advanced until the end of the year, when we were paying 11½ cents or 53*s*. per cwt. c.i.f. The total crop was small as the opening prices did not encourage the peelers, and the main advance did not take place until after the peeling season was over. Our last offer from the Pacific Coast—a fortnight ago—was at 13 cents per lb. c.i.f.—practically 60*s*. per cwt.—and our shippers tell us that there is not more than 50 tons of bark on the whole of the Pacific North-west.

" It is too early yet to attempt a forecast of the opening prices for this season's peel. The logging mills out there are all working full time, and the men who work in the mills have heretofore peeled bark. To-day they can make as high as $9.00 a day as a mill hand, so there is very little encouragement to peel bark unless the price offered is well above last season's opening figures. Our shippers estimate that the new season's bark will not open lower than to-day's figure—60*s*. per cwt. c.i.f.—but this will cause buyers to hold off and prices may ease in consequence, although not to any material extent.

" The Kenya product will have the advantage of the 10 per cent. preferential duty in this country, and now would seem a very favourable season for the shippers there to obtain

remunerative prices. They will have to be prepared, however, to accept something under the above figures on account of the prejudice, at first, of the buyers against the thin papery appearance " (April 5, 1937).

(*b*) " We have now had an opportunity of examining the sample of cascara bark from Kenya which you sent to us. We find that this does not conform to the British Pharmacopœia description as it is in thinner quills, but we do not think that this point is objectionable provided that the bark is active.

" We are afraid, however, that the only satisfactory test would be a physiological one. This would entail keeping the bark for a year and then manufacturing a liquid extract from it, so that this may be administered in the usual way. If you would like us to do this, we are quite willing to carry it out, but would prefer to have a larger quantity of the bark, say 56 lb., for our use."

This sample of cascara bark compared very favourably with previous samples from Kenya received at the Imperial Institute. The bark was, however, very thin and papery, indicating that it was probably collected from young trees (or possibly from trees which had developed in the form of bushes). It is likely to be saleable, as will be seen from the merchant's report, but thicker bark would be more attractive. If the material was obtained from young trees it would be advisable in future to defer stripping until the trees are a year or two older, by which time the bark should have increased in quantity and thickness. Such bark would normally realise a price nearer to that of the usual commercial cascara bark from the Pacific Coast.

The offer of the firm of manufacturing druggists to store a quantity of the bark for a year and then prepare an extract from it for physiological trial was greatly appreciated by the Department of Agriculture and in August 1937 two sacks of the bark were received for this purpose. The outcome of the trials will be awaited with much interest.

ARTICLES

FINDING A MARKET FOR EMPIRE TIMBERS

WORK OF THE IMPERIAL INSTITUTE

By Dr. S. E. Chandler

Principal, Plant and Animal Products Department, Imperial Institute

A Talk Broadcast on August 19, 1937, Introductory to the Series " Trees into Timber " arranged for Empire listeners by the British Broadcasting Corporation.

I expect I have been asked to introduce these talks on Empire Timbers because for the last twenty-one years I have been the Secretary of the Timbers Committee of the Imperial Institute at South Kensington. That Committee, composed of timber merchants, architects and manufacturers, as well as officials and technical people, was set up to encourage the use of Empire timbers in Britain. We wanted to tell people that the overseas countries possessed excellent timbers—mostly unknown to them—which could be used with complete success in place of the imported foreign woods. The position was—still is—that by far the greater part of the timber used in the United Kingdom is imported; and, in point of value, nine-tenths of it came from foreign countries, as we knew to our cost during the war. In fact, it was the war which brought up this question of Empire timber.

Now, Empire timbers were no novelty. Eastern Canadian spruce, pine and birch, Burma teak, British Honduras mahogany, greenheart from British Guiana, Ceylon satinwood, Australian jarrah—they had been used for generations. But " nine-tenths of our imports were of foreign origin " ; that was the point. There was not the remotest chance of this country producing all the timber needed, but it would benefit Imperial interests if as much as possible came from the Empire—always provided that the Forestry Officers regulated the felling, because reckless destruction of forests does immense harm to a country : that is one reason why we hear so much about Soil Erosion nowadays—I think you all know what that means.

So my Committee examined timbers from all likely parts

of the Empire; woods little known, others quite unknown in England. Tests were made, and then we published a Descriptive List of the woods we recommended. In the same year (1928) an Empire Timber Exhibition was opened at the Imperial Institute. It was a very practical affair, in which the trade and your Forest Departments co-operated nobly. Only those woods which you were already marketing, or wanted to market, or which the Committee recommended, were exhibited (some of you may remember sending us planks). A special feature was articles made from the woods; they ranged from pianos, panelling and motor cars to billiard tables and turnery. It is really true to say that the Exhibition did much to advance the trade in your timbers. Since that time the good work has been energetically taken up by the trade, by the Empire Marketing Board, the Research Laboratory at Princes Risborough and a special Department of the Colonial Office. The result is that, at the present time, Empire timbers are really well established in this market: all up-to-date merchants supply them, they are specified in official contracts, and the woods are in wide use for all sorts of work: and, of course, they enjoy a tariff preference.

Let me mention a particular case. Our special need in this country is for constructional softwoods—like pine, fir, spruce. The traditional source of supply is Northern Europe—the Baltic countries and Russia. Only one Empire country can help us here; that is Canada, and especially Western Canada.

The rise of British Columbia timbers in this country, as we saw it at the Imperial Institute, is a very interesting story. It all dates from a letter sent in 1915 by the Agent-General to our Director deploring that British Columbia timbers were not in the contract specifications of H.M. Office of Works. They were scarcely known in this country then. We offered to take up his case with the Powers That Be and the Agent-General accepted. With a colleague I was sent down to see the Principal Architect of the Office of Works, the late Sir Frank Baines. We had previously sent on some planks of Douglas fir, Western hemlock, Sitka spruce and red cedar, taken from our Canadian Court; and I explained their virtues. Mr. Baines, as he was then, soon made up his mind. He said he would try out the woods: if they were as good as the foreign

timbers he was using, and if supplies and grades were all right, he would put them in his specifications. Would we obtain a shipment for him? Of course we would; and the Agent-General made the arrangements.

Months passed, but we could learn nothing of the wood. At last we heard that a consignment had been shipped in the s.s. *Mount Temple*: she had been sunk by an enemy submarine and the shipment lost. Another consignment was shipped, and arrived. After tests, Mr. Baines used the woods (chiefly Douglas fir) for joinery, flooring, and so on in public buildings. In due course he reported them entirely satisfactory and, true to his word, the timbers went into the official specifications, together with some Eastern Canadian woods which had been tried out meanwhile. As soon as it was known (and we took care it was known) that the Office of Works were using the woods, municipal authorities all over the country made enquiries, and timber merchants and shippers became active. The London County Council then asked my Committee if Douglas fir could be safely used for their new housing schemes: we said "yes, certainly"; and used it was, and is. Meanwhile, the Lumber Commissioners, first Mr. Loren Brown and then Mr. Douglas Roe, had got very busy indeed and, with the help of the Ottawa Preference, the use of the woods spread rapidly. What are the figures? Before the matter was taken up, about 2 per cent. of the British Columbia export came to this country; to-day the figure is nearly 40 per cent.

Now, I am not asked to give you the story of other Empire woods because in this series of talks they will be covered by other speakers. But what may interest you from me is some reference to the chief problems which my Committee have encountered during their pioneer work and the general principles which we have impressed upon those anxious to develop a trade in Empire timbers. It all appears so simple now that business is fairly well launched, but there is no harm—and probably good—in emphasising some of the essentials.

The first point may seem obvious, but I am afraid it has not always been appreciated. It is this: it is useless to expect business in timbers which cannot be shipped in commercial quantities—and regularly. The Canadian softwoods are available in abundance, as are a number of other timbers, so this observation is offered mainly as regards new hardwoods.

Merchants and users get very annoyed, and prejudiced against later enterprises if, after they have gone to the trouble of proving a new timber to be commercially and technically desirable, they find that supplies are short or irregular.

Of course, connected with this commercial point is the fundamental matter of price. In any case, a competitive price is most desirable in offering a new commodity, but it is positively essential if your timber is proposed as an Empire substitute for an established—and highly satisfactory—foreign wood : from which it follows that the timbers marketed must also be good ones—the best you have.

Then, if new or little-known woods are to receive the attention they deserve it is important to have ready full information about their properties and uses to put before likely buyers in this country. Formerly, we carried out the necessary strength tests and working trials at the Imperial Institute, but, with the setting up of the Forest Products Research Laboratory at Princes Risborough, this work was handed over to them. So now there is available a special institution for finding out what merchants, architects and manufacturers really want to know when asked to take up this or that timber. Great use is made of the facilities offered by this valuable research laboratory which not only tests the strength and mechanical properties of the woods but carries out working trials with all kinds of tools and, among other things, investigates seasoning problems and the damage done to timbers by insect pests and fungal diseases.

The natural outcome of all this kind of work is literature giving particulars of the different woods. I have mentioned the Descriptive List published by my Committee : this was the basis of the later Empire Marketing Board handbook. The Lumber Commissioners, and the trade itself, put out excellent pamphlets, and there are the Princes Risborough reports. The trade exhibitions held in London and elsewhere almost always have a good display of your timbers. In the last few years, too, there has been set up a special branch of the Colonial Office to deal with colonial woods : so you see there is no lack of interest in Empire timbers in this country.

Then there is a most important matter if you are shipping sawn timber—grading and manufacture. The United Kingdom market is canvassed by shippers from all exporting

countries, and Empire shippers should always remember that the foreign woods with which they must compete are well graded and usually exceedingly well manufactured—that is, accurately sawn and true to measurement. Empire softwoods are now shipped in grades to meet the particular needs of this market, and full attention is paid to manufacture—a notable piece of good business. In the case of new or little-known Empire hardwoods a special difficulty was the absence of a generally accepted set of grading rules. My Committee, under the experienced guidance of the Chairman, Mr. James Fraser, therefore produced a set of Grading Rules for boards and planks intended for this market. These rules have been approved by the Timber Trade Federation of the United Kingdom and a second edition, embodying amendments recommended by yourselves, will shortly be issued.[1] You are strongly recommended to adopt these rules, which are simple and practical.

Now comes a very delicate matter—the names under which Empire timbers should be marketed. It is a most difficult subject, and in anything I say you could easily charge me with inconsistency. The trade has already given odd names to some timbers which they think will "sell" the woods, but such names are not always desirable: and sometimes your own names for the woods would not appeal to this market. However, there are guiding principles in the matter: there should be one trade name only for each wood; and that name should be a practical one. "Native" names by all means, if suitable: iroko from West Africa, Australian jarrah and karri, Borneo seraya, Malayan meranti, Andaman padauk —mahogany, for that matter—they are all "native" names, and now commercial commonplaces; but you cannot expect timber merchants to stomach "Obobonekwi," not even from Nigeria! So it is proposed to call that wood "Guarea" after the botanical name, for it is surprising how the trade and others are taking to botanical names: for example, "Mansonia" from Nigeria is firmly established in this market. But, please, do not call a wood "teak" if it is not true teak: it does your wood no good in the long run. If your timber is a good one it will stand on its own merits under its own name. To help solve your difficulties, the Empire Forestry Association

[1] The new edition of the Rules is now published (see opposite).

have produced, in consultation with your forestry officers and the trade, a list of Standard Trade Names of Empire Timbers. The list is quite practical—to the extent of accepting cases of established names even if they are not all that could be desired.

I should like to have one final word : exploit your timbers ; but, above everything, conserve your forests.

GRADING RULES AND STANDARD SIZES FOR EMPIRE HARDWOODS

(SQUARE-EDGED BOARDS AND PLANKS)

INTENDED FOR SHIPMENT TO THE UNITED KINGDOM

Second Edition, 1937

Prepared by the Imperial Institute Advisory Committee on Timbers

PREFACE

The origin and purpose of the Imperial Institute Grading Rules and Standard Sizes for square-edged hardwoods from Empire countries are set out in the Introduction to the first edition, published in 1933 (see this BULLETIN, 1933, **31**, 536). A second edition of the Rules is now issued as the outcome of the response made to the invitation extended to overseas authorities, central standardising bodies, and trade interests concerned in this country, to whom the Rules were widely circulated, to forward to the Imperial Institute suggestions for amendments to the Rules considered desirable in the light of local knowledge and experience. A number of valuable suggestions has been received for consideration, and the Advisory Committee, under the guidance of the Chairman, Mr. James P. Fraser, have had the advantage of discussing the proposals with technical officers from the countries concerned and also with members of the trade in this country. Mr. G. L. Wright, since his appointment to the Advisory Committee, has also served on the Grading Sub-Committee. A large measure of agreement has been reached in regard to the proposed amendments, and the approved alterations have been incorporated in the second issue of the Grading Rules and Standard Sizes now published.

With further experience of the working of the Rules the desirability of additional modifications will no doubt become apparent in order to keep abreast of trade developments, but it is recommended that the Grading Rules as now issued should be used in commerce pending the preparation of the National Specifications for Timber (Softwoods and Hardwoods) for Great Britain, referred to in the Introduction to the first edition. Recommendations for further amendments will be welcomed, and should be addressed as heretofore to the Director, Imperial Institute, London, S.W.7.

H. A. F. LINDSAY,
Director, Imperial Institute.

GRADING RULES FOR EMPIRE HARDWOODS (SQUARE-EDGED BOARDS AND PLANKS)

Note.—The Rules apply to timber at the time of receipt and not at the time of shipment.

I. STANDARD GRADES

1. **First Grade or Prime.**—Boards and planks to be 6 inches and up wide, and 8 feet and up long. They must be flat, well and evenly cut, full to thickness and have parallel edges. All pieces containing less than 8 feet face measure must be free from defects. Pieces containing from 8 to 12 feet face measure will admit one standard defect. Pieces containing from 12 to 16 feet face measure will admit two standard defects, and over 16 feet face measure three standard defects. At least x per cent. of the material as a whole must be free from defects; the value of x for the principal timbers concerned is stated in Appendix II. A standard defect is one as defined in the attached Schedule (Appendix I).

The following *tolerances* in thickness are recognised:—

(*a*) $\frac{1}{16}$ inch over-size on 1 inch boards and under.

(*b*) $\frac{1}{8}$ inch over-size on boards over 1 inch and up to 2 inches.

(*c*) $\frac{1}{4}$ inch over-size on planks over 2 inches.

No undersize to be allowed.

2. **Second Grade.**—Boards and planks to be 4 inches and up wide, and 6 feet and up long. They must be well cut, and

full to thickness and have parallel edges except that not more than 5 per cent. of boards or planks which show slight local irregularities in sawing and which otherwise would be First Grade or Prime will be admitted. The variations in thickness in such boards and planks must not exceed $\frac{1}{16}$ inch under or $\frac{1}{8}$ inch over in any thickness up to 2 inches: in planks over 2 inches in thickness the maximum variation allowed will be $\frac{1}{8}$ inch under and $\frac{1}{4}$ inch over the contract thickness.

The same *tolerances* in over-thickness in well-sawn lumber are allowable in Second Grade lumber as in First Grade.

Boards and planks of Second Grade must give not less than the following percentages of clear lumber :—

Pieces from 2 to 4 feet surface measure, 75 per cent. of clear lumber in one cutting.

Pieces from 5 to 7 feet surface measure, 75 per cent. of clear lumber in two cuttings.

Pieces from 8 to 10 feet surface measure, 75 per cent. of clear lumber in three cuttings.

Pieces from 11 to 13 feet surface measure, 75 per cent. of clear lumber in four cuttings.

Pieces with 14 feet or over surface measure, 75 per cent. of clear lumber in five cuttings.

No cutting to be admitted which is less than 3 feet long by 3 inches wide, or 2 feet long by 4 inches wide.

3. **Country Mill Stock.**—The grading of Country Mill Stock to be identical with the grading of ordinary stock except in so far as thickness is concerned ; a *tolerance* not exceeding $\frac{1}{4}$ inch over the contract thickness will be allowed in 1 inch, $1\frac{1}{4}$ inch and $1\frac{1}{2}$ inch stock ; and not exceeding $\frac{3}{8}$ inch on thicker stock. All stock sold as Country Mill Stock must be specially branded or indelibly marked as "Country Mill Stock."

II. Wormy Grades

1. **Prime Wormy.**—Boards and planks to be 6 inches and up wide, 6 feet and up long, but not more than 20 per cent. of the number of the pieces to be less than 8 feet long.

Splits not exceeding 6 inches in aggregate length will be admitted at one or both ends, but otherwise the boards or planks must be free from all defects except pin worm holes and shot worm holes.

Boards and planks of Prime Wormy Grade must give not less than the following percentages of clear lumber free from pin worm holes or shot worm holes :—

Pieces containing less than 8 feet surface measure, 75 per cent. of clear lumber in one cutting.

Pieces containing from 8 to under 12 feet surface measure, 75 per cent. of clear lumber in two cuttings.

Pieces containing from 12 feet and up surface measure, 75 per cent. of clear lumber in three cuttings.

No cutting to be admitted which is less than 3 feet long by 3 inches wide, or 2 feet long by 4 inches wide.

2. **Second Prime Wormy.**—Boards and planks to be 6 inches and up wide, 6 feet and up long, but not more than 20 per cent. of the number of the pieces to be less than 8 feet long. Splits not exceeding 6 inches in aggregate length will be admitted at one or both ends, but otherwise the boards or planks must be free from all defects except pin worm holes and shot worm holes. Pin worm holes and shot worm holes are admitted without limit.

3. **No. 1 Common Wormy.**—To grade as in the standard grade of Second Grade except that pin worm holes and shot worm holes will be admitted without limit.

III. Grades for Shorts, Squares, Strips, Quarter-Sawn Stock

Shorts

First Grade or Prime Shorts to be free from all defects unless otherwise contracted for. The timber to be 6 inches and up wide, 3 feet and up long, rising by half feet up to 7 feet 6 inches.

Second Grade Shorts to be 4 inches and up wide, 3 feet and up long, and to cut 75 per cent. clear in one cutting from pieces up to 4 feet long. In pieces over 4 feet long to cut 75 per cent. clear in two cuttings.

N.B.—Shorts should be measured and tallied as if four times the actual length. The resulting total divided by four gives the true contents of the parcel.

SQUARES

First Grade or Prime Squares must be free from all defects, except that, where squares are sold specifically for turning, slight defects on one or more corners which will turn off will be admitted. The specification of sizes will be as agreed between the parties to the contract.

STRIPS

First Grade or Prime Strips, unless otherwise agreed, must be free from all defects and straight. The specification of sizes will be as agreed between the parties to the contract.

Second Grade Strips must give 75 per cent. clear in two cuttings from all lengths under 12 feet. In lengths of 12 feet and up, 75 per cent. clear in three cuttings.

N.B.—No cutting shall be considered which is less than 2 feet long.

QUARTER-SAWN STOCK

The specifications of sizes and grades in quarter-sawn stock will be the same as in plain-sawn stock, with the following exceptions :—

(*a*) **First Grade or Prime.**—In widths of 8 inches and up, 1 inch of bright sapwood will not be considered a defect. In widths under 8 inches no sapwood will be admitted.

N.B.—Any sapwood additional to that provided for above will be treated as a defect, each additional inch or less of bright sapwood being considered one defect.

(*b*) **Second Grade.**—In widths of 8 inches and up, 1½ inches of bright sapwood will not be considered a defect.

N.B.—No sapwood additional to that admitted above will be considered as a usable timber.

GENERAL NOTES TO GRADING RULES

1. Grading of rough lumber shall be done on the worse face, and of dressed lumber on the better face. In flooring strips of Australian timbers (*Eucalyptus*) slight gum streaks or veins will be permitted on one face.

2. When defects or blemishes or combination thereof not described above (and not dealt with under Grading Rules) are encountered they will be considered as equivalent to known defects according to their damaging effect upon the piece under inspection.

3. Seasoning checks which are so serious in character as to damage the lumber shall not be admitted in the cuttings, but slight ordinary seasoning checks shall be admitted.

4. When straight-grained timber is specified, the angle of grain shall not exceed 1 in 25.

5. The grading of dimension stock, e.g., flooring, must be the subject of special agreement between shipper and buyer.

6. The amount of sapwood in any board will be calculated on the average width of such sapwood throughout the length of the piece.

APPENDIX I

SCHEDULE OF STANDARD DEFECTS

Rule No.	Description.	Value.
1.	One (sound[1]) knot $\frac{5}{8}$ inch to $1\frac{1}{4}$ inches diameter or equivalent . . .	= 1 defect
2.	One (sound[1]) knot over $1\frac{1}{4}$ inches to $2\frac{1}{2}$ inches diameter or equivalent . .	= 2 defects
3.	One (sound[1]) knot over $2\frac{1}{2}$ inches to $3\frac{1}{2}$ inches diameter or equivalent . .	= 3 defects
4.	Two (sound[1]) knots under $\frac{5}{8}$ inch diameter or equivalent	= 1 defect
5.	Three (sound[1]) knots under $\frac{5}{8}$ inch diameter or equivalent	= 2 defects
6.	One or more pin worm holes in group not exceeding $1\frac{1}{4}$ inches diameter .	= 1 defect
7.	One or more shot worm holes or equivalent in group not exceeding $1\frac{1}{4}$ inches diameter	= 1 defect
8.	One end split, or splits at each end, not exceeding in total length in inches the surface measure of the piece in square feet, each split opening out not more than 1 inch to the foot in length .	= 1 defect

[1] An unsound knot will be considered the equivalent of two sound knots of similar size.

Rule No.	Description.	Value.
9.	One end split, or splits at each end, not exceeding in total length in inches the surface measure of the piece in square feet, each split opening out more than 1 inch and under 2 inches per foot in length	= 2 defects
10.	One inch or under of bright sapwood on one edge or its equivalent on both edges	= 1 defect
	Each additional inch or part of an inch of bright sapwood shall be considered as equal to one defect.	
	Sapwood in Obeche.—No sapwood to be allowed in Obeche (*Triplochiton* spp.)	
	Sapwood in Abura.—Bright sapwood is no defect in Abura (*Mitragyna stipulosa* Kuntze).	
11.	Free side bend (spring) admitted as follows:	
	In pieces 8 to 9 feet long . .	½ inch.
	,, ,, 9 to 12 feet long . .	¾ inch.
	,, ,, 12 to 16 feet long . .	1¼ inches.
	Each additional half inch of side bend (spring) in all lengths	= 1 defect
	Not more than two such defects allowed in any piece.	

DEFECTS CHARACTERISTIC OF SPECIFIED TIMBERS

Rule No.	Description.	Value.
12.	**Gum Streaks and Gum Pockets in African Walnut.** In African Walnut (*Lovoa klaineana* Pierre ex Sprague) gum streaks and gum pockets less than 3 square inches in total area per board will not be regarded as defects; but gum streaks or gum pockets—	
	if over 3 square inches and not exceeding 5 square inches in total area per board	= 1 defect
	if over 5 square inches and not exceeding 10 square inches in total area per board	= 2 defects
	if over 10 square inches and not exceeding 15 square inches in total area per board	= 3 defects

Rule No.	Description.	Value.
13.	**Gum Veins in Australian Timbers**—	
	One gum vein $\frac{3}{32}$ inch wide and not greater than 12 inches long, or its equivalent	= 1 defect
	For each additional gum vein, or each additional foot of length .	= 1 defect

APPENDIX II

Statement of Percentages of Material (sawn lumber) of specified timbers which must be free from defects in order that the lumber may be graded as First Grade or Prime.

Note.—The percentages to be calculated on the number of pieces in the parcel and not on the area or volume of the parcel.

[1]Abura (*Mitragyna stipulosa* Kuntze) . .	60 per cent.
Afara (*Terminalia superba* Engl. et Diels) .	60 ,,
[2]African Walnut (*Lovoa klaineana* Pierre ex Sprague)	50 ,,
Agba (*Gossweilerodendron balsamiferum* Harms)	60 ,,
[3]Australian Walnut (*Endiandra palmerstonii* C. T. White)	80 ,,
Australian Blackwood (*Acacia melanoxylon* R.Br.)	75 ,,
Black Afara (*see* Idigbo)	
Blackbean (*Castanospermum australe* A. Cunn.)	80 ,,
[4]Borneo Camphor Wood (*Dryobalanops* spp.) .	70 ,,
Burma Mahogany (*see* Thitka)	
Ceylon Gurjun (*see* Hora)	
Cherry Mahogany (*see* Makore)	
Crabwood (*see* Empire Andiroba)	
[5]Danta (*Cistanthera papaverifera* A. Chev.) .	60 ,,
Empire Andiroba (*Carapa guianensis* Aubl.) .	60 ,,
Eng (*Dipterocarpus tuberculatus* Roxb.) . .	90 ,,
Guarea (*Guarea thompsonii* Sprague et Hutch.)	80 ,,
Guarea, scented (*Guarea cedrata* Pellgr. ex A. Chev.)	80 ,,
Gurjun (*Dipterocarpus* spp.)	90 ,,

[1] *See* Appendix I, rule 10.
[2] *See* Appendix I, rule 12.
[3] *See* Appendix IV.
[4] All shipments to be entirely free from sapwood.
[5] Gold Coast name.

Haldu (*Adina cordifolia* Hook. f.) . . .	75 per cent.
Hora (*Dipterocarpus zeylanicus* Thev.) . .	80 ,,
Idigbo (*Terminalia ivorensis* A. Chev.) . .	60 ,,
Indian Silver Greywood (*Terminalia bialata* Wall.)	90 ,,
Indian White Mahogany (*see* White Dhup)	
Iroko (*Chlorophora excelsa* Benth. et Hook. f.)	60 ,,
Iroko, East African (*Chlorophora excelsa* Benth. et Hook. f.)	60 ,,
[1]Kapur (from Malaya) (*Dryobalanops* spp.) .	70 ,,
[1]Keruing (from Malaya) (*Dipterocarpus* spp.) .	80 ,,
[1]Keruing (from Sarawak) (*Dipterocarpus* spp.) .	80 ,,
[1]Keruing (from Borneo) (*Dipterocarpus* spp.) .	80 ,,
Mahogany, African (*Khaya* spp.) . . .	80 ,,
Mahogany, Burma (*see* Thitka)	
Mahogany, Cherry (*see* Makore)	
Mahogany, Honduras (*Swietenia macrophylla* King)	65 ,,
Makore (*Mimusops heckelii* Hutch. et J. M. Dalz.)	60 ,,
Mansonia (*Mansonia altissima* A. Chev.) .	50 ,,
Meranti, red (*Shorea* spp.)	80 ,,
Mountain Ash (chiefly *Eucalyptus regnans* F. Muell.) *see* special rules, Appendix IV .	90 ,,
Mvule (*see* Iroko, East African)	
[2]Obeche (*Triplochiton* spp.)	80 ,,
Obobonekwi (*see* Guarea)	
Obobonufwa (*see* Guarea, Scented)	
Ofun (*see* Mansonia)	
Opepe (*Sarcocephalus diderrichii* De Wild.) .	60 ,,
[3]Otutu (*Cistanthera papaverifera* A. Chev.) .	60 ,,
Padauk, Andaman (*Pterocarpus dalbergioides* Roxb.)	75 ,,
Padauk, Burma (*Pterocarpus macrocarpus* Kurz)	75 ,,
Pyinkado (*Xylia dolabriformis* Benth.) . .	75 ,,
Pyinma, Andaman (*Lagerstroemia hypoleuca* Kurz)	75 ,,
[4]Queensland Kauri (*Agathis palmerstonii* F. Muell.)	80 ,,

[1] All shipments to be entirely free from sapwood.
[2] *See* Appendix I, rule 10.
[3] Nigerian name.
[4] Botanically a softwood, but handled by the hardwood trade.

Queensland Maple (*Flindersia brayleyana* F. Muell.)	70 per cent.
Sapele (*Entandrophragma cylindricum* Sprague)	80 „
Seraya, red (*Shorea* spp.)	80 „
Seraya, white (*Parashorea* spp.)	80 „
Silky Oak (*Cardwellia sublimis* F. Muell.) .	80 „
Tasmanian Myrtle (*Nothofagus cunninghamii* Oerst.)	60 „
(*Intermediate wood admitted if not discoloured*)	
Tasmanian Oak (chiefly *Eucalyptus obliqua* L'Hérit.) (*see* special rules, Appendix IV).	
Thitka (*Pentace burmanica* Kurz). . . .	90 „
Victorian Oak (*see* Mountain Ash)	
White Bombway (*Terminalia procera* Roxb.) .	75 „
White Chuglam (*Terminalia bialata* Wall.) .	90 „
(*Natural coloration admitted if no decay present.*)	
White Dhup (*Canarium euphyllum* Kurz) .	75 „

APPENDIX III

Definitions of Technical Terms occurring in the Grading Rules

Back Sawn.—An Australian synonym of flat-sawn (q.v.).

Blemish.—Of the same nature as a defect (q.v.) but, considered by itself, so slight as to be negligible.

Board.—A piece of square-sawn converted timber less than 2 inches in thickness, the thickness to be uniform throughout the length of the piece.

Clear.—Free from defects.

Cutting.—A rectangular section cut from a board or plank.

Defect.—A fault either natural or induced tending to lower the value of the timber.

Dimension stock.—Squared timber cut to special sizes other than the standard widths, thicknesses and lengths.

Face measure and *surface measure.*—The area in square feet of one face of a board.

Flat-sawn.—Timber converted so that the growth-rings meet the face over at least half its width at an angle of less than 45 degrees.

Free side bend.—Slight curve to one side in the same plane as the face of the board or plank.

Gum pocket.—In African walnut a gum pocket is an excessive accumulation of a dark-coloured resinous substance which alone, or with the adjacent wood detrimentally affected thereby, exceeds one-eighth of an inch in breadth as seen on the surface of a board or plank.

(*Note.*—Gum pockets are not necessarily in the form of a large gum streak. They and the adjacent wood detrimentally affected frequently form a patch more or less circular in shape.)

Gum streak.—In African walnut a gum streak is an accumulation of a dark-coloured resinous substance which appears as a line or ribbon not exceeding one-eighth of an inch in breadth as seen on the surface of a board or plank.

Gum vein.—An excessive accumulation of gum or kino in the form of a vein or ribbon between growth rings which may be bridged radially at short intervals by woody tissue.

Intermediate wood.—Wood intermediate in character between sapwood and heartwood (truewood). Intermediate wood is a recognised feature of certain timbers, e.g. Tasmanian myrtle where it is normally recognised in the trade as heartwood.

Knot, size of.—The size of a knot shall be taken as the mean of its greatest and least diameters in inches.

Large worm hole.—A worm hole over $\frac{1}{8}$ inch diameter.

Pin worm hole.—A worm hole not over $\frac{1}{16}$ inch diameter.

Plain-sawn.—*See* Flat-sawn.

Plank.—A piece of square-sawn converted timber similar to a board (q.v.) but 2 inches or more in thickness.

Quarter-sawn.—Timber cut along, or in the general direction of the rays.

Seasoning check.—A slight check occurring on the surface during seasoning, which is likely to close up when seasoning is complete.

Shorts.—A short length of board or plank not exceeding 6 feet long.

Shot worm hole.—A worm hole over $\frac{1}{16}$ inch and not exceeding $\frac{1}{8}$ inch diameter.

Square.—A length of timber of square cross-section throughout.

Strip.—A narrow board not over $5\frac{1}{2}$ inches in width.

Wane.—The portion of the original rounded surface of a tree remaining on a piece of converted timber.

APPENDIX IV

Special Clauses in Contracting for Certain Timbers

TASMANIAN OAK (*Eucalyptus obliqua* L'Hérit., *E. regnans* F. Muell., *E. gigantea* Dehnh. syn. *delegatensis* R. T. Baker).

MOUNTAIN ASH (VICTORIAN OAK) (*Eucalyptus regnans* F. Muell., *E. gigantea* Dehnh. syn. *delegatensis* R. T. Baker).

The Grades to be as follows:

Undressed Sawn Boards (up to 2 inches thick):

1. **Prime or Selected.**—Sound quarter-sawn truewood (heartwood), one clean face free from all defects, and to conform to dimensions specified by purchaser. Lengths 6 feet and upwards. Back-sawn timber and timber under 6 feet in length to be supplied only when specially ordered.

2. **Motor Body Grade or Merchantable.**—Sound quarter-sawn truewood (heartwood) free from gum pockets, knots, want, wane, sapwood, insect holes, and cross-grain, but may contain gum veins on the face of the board not exceeding $\frac{3}{32}$ inch wide; in timber up to 4 inches wide the total length of gum veins not to exceed half of the length of the piece; over 4 inches wide and up to 8 inches not to exceed threequarters of the length of the piece; and over 8 inches up to 12 inches not to exceed the total length of the piece; but free from all other defects and to conform to dimensions specified by purchaser. Lengths 6 feet and upwards. Back-sawn timber and timber under 6 feet in length to be supplied only when specially ordered.

Note.—It is recommended that Tasmanian Oak be imported only as kiln dried and re-conditioned timber.

AUSTRALIAN WALNUT (*Endiandra palmerstonii* C. T. White). Percentages of quarter-sawn and plain-sawn stock to be as agreed between the parties to the contract.

APPENDIX V

Timbers excepted from the Grading Rules

1. AUSTRALIAN HARDWOODS:

   JARRAH (*Eucalyptus marginata* Sm.).

   KARRI (*Eucalyptus diversicolor* F. Muell.).

   MOUNTAIN ASH (VICTORIAN OAK) (*Eucalyptus regnans* F. Muell., chiefly) (*see* Appendix IV).

   TASMANIAN OAK (*Eucalyptus obliqua* L'Hérit., chiefly) (*see* Appendix IV).

2. NEW ZEALAND HARDWOODS.

3. TEAK (*Tectona grandis* L.f.).

4. BRITISH HONDURAS MAHOGANY (*Swietenia macrophylla* King): to be graded according to the Rules of the National Hardwood Lumber Association.

5. CANADIAN HARDWOODS:

   (*a*) may be classified as "Merchantable" or "Prime."

   (*b*) may be graded according to the rules of the National Hardwood Lumber Association.

Note.—"Merchantable" and "Prime" are not strictly defined grading rules, but classifications established through long practice and usage.

6. NEWFOUNDLAND HARDWOODS: to be graded as in the case of Canadian hardwoods.

MEMORANDUM ON SIZES OF EMPIRE HARDWOODS (SQUARE-EDGED)

INTENDED FOR SHIPMENT TO THE UNITED KINGDOM

The following is a list of sizes in common use in some of the timber-consuming industries in the British Isles. Other sizes are asked for from time to time but those in the list are suitable for general requirements.

A very definite word of warning in regard to two points must be sent out with this list.

In parts of the Empire certain timbers have been found suitable locally for joinery work or for cabinet work, but it does not follow, by any means, that the same timbers will be

acceptable for similar work in the British Isles. Other timbers from different parts of the Empire might conceivably be much more satisfactory in England by reason of their beauty, cost or reliability and sawmill operators are therefore warned that there may be grave danger *in cutting quantities of their own timbers to these sizes without first testing the demands in the English market.*

The second point deals more particularly with the question of sizes in squares for chair legs, table legs and similar work. Owing to the stress of competition and financial stringency it is quite common to-day to use a square 1½ inches × 1½ inches for the front leg of a chair where before the standard size was 2 inches × 2 inches. Also, the fashion changes as to whether chairs are made with or without castors; in the former case, naturally, a shorter square is required than in the latter case. Shippers are therefore warned that it would be dangerous to produce any large quantities of squares except against definite orders.

Joinery Work.—The best thicknesses for woods to be used in joinery work are 1¼ inches, 1½ inches and 2 inches. About 60 per cent. of the production should be in these sizes. Of the remainder about 15 per cent. should be in 1 inch thickness, 20 per cent. in 2½ inches, 3 inches and 4 inches, and about 5 per cent. in 5 inches and 6 inches.

If a saw miller wishes to cut his wood into joinery sizes it will usually be necessary for him to cut a certain proportion into each of the above thicknesses.

For joinery work there is also a limited demand for long squares, i.e. principally 4 inches × 4 inches, 5 inches × 5 inches from 8 to 16 feet long.

Floorings.—The best sizes for hardwood floorings are:

1 inch × 3 inches.

1 inch × 4 inches.

In all sizes floorings should be cut full to thickness and full to width and free from sapwood.

Cabinet Work.—The usual thicknesses in cabinet work are ½ inch, ⅝ inch, ¾ inch and 1 inch. By far the largest demand is for 1 inch, with ¾ inch at times used as a substitute for

1 inch in cheaper work. Thicknesses of ½ inch and ⅝ inch are used in considerable quantities for such work as drawer sides and wardrobe backs.

In the cabinet trade there is a limited demand for 1¼ inch, 1½ inch and 2 inch thicknesses.

Cabinet squares.—Subject to the variations in fashion the best sizes in short squares for chair-making, table legs and similar work are the following:

1½ inches × 1½ inches × 19 inches, 24 inches, 28 inches, 30 inches, 36 inches, 42 inches, 48 inches, 54 inches.

1¾ inches × 1¾ inches × 19 inches and 30 inches.

2 inches × 2 inches × 19 inches, 24 inches, 28 inches, 30 inches, 36 inches, 42 inches, 48 inches, 54 inches.

2½ inches × 2½ inches × 19 inches, 24 inches, 28 inches, 30 inches, 36 inches, 42 inches, 48 inches, 54 inches.

3 inches × 3 inches × 19 inches, 24 inches, 28 inches, 30 inches, 36 inches, 42 inches, 48 inches, 54 inches.

3½ inches × 3½ inches × 19 inches, 24 inches, 28 inches, 30 inches, 36 inches, 42 inches, 48 inches, 54 inches.

4 inches × 4 inches × 19 inches, 24 inches, 28 inches, 30 inches, 36 inches, 42 inches, 48 inches, 54 inches and 6 feet and up.

THE CONSULTATIVE COMMITTEES OF THE IMPERIAL INSTITUTE

AN important feature of the organisation of the Imperial Institute is the series of Consultative Committees (originally described as Advisory Technical Committees) comprising authorities on various groups of raw materials, which have been set up in association with the departmental Advisory Councils to advise in connection with the technical work of the Plant and Animal Products Department and the Mineral Resources Department. On the reorganisation of the Institute in 1926 the value of the work already done by the Advisory Committees on Timbers, Silk, Rubber, and Minerals was recognised, and it was decided to appoint similar bodies dealing

with other commodities with a view to extending the scope of the services available for carrying out the work of the Institute. On the incorporation of the Imperial Mineral Resources Bureau within the organisation of the Institute as the Mineral Resources Department, the existing advisory committees of the former Bureau were brought under the same scheme. Arrangements were made for the committees to be subject to the general supervision of the departmental Advisory Councils, which were appointed to advise on matters relating to the utilisation of Empire raw materials and to initiate schemes of work which might be undertaken by the Imperial Institute. The Chairmen of the Committees were nominated as members of the Advisory Councils in addition to official and scientific representatives.

The system has proved of great value. The membership of the Committees includes representatives of the commercial and professional interests concerned, technical experts, and members nominated by official departments. The Chairman of the appropriate Advisory Council and the Director of the Imperial Institute are *ex officio* members of all the Committees and members of the Imperial Institute technical staff are appointed to act as Secretaries. The value of the services rendered by the Committees results from the standing, knowledge, and experience of the personnel and from the unstinted assistance afforded, which is given without remuneration. Grateful acknowledgment is here made to the Chairmen and members of the Committees.

A complete list of the Consultative Committees of the two departments of the Institute, with full membership, will be published with the next number of this BULLETIN.

PLANT AND ANIMAL PRODUCTS DEPARTMENT

The Committees of this Department are chiefly concerned with advising in regard to special technical problems received at the Imperial Institute. They further promote investigations designed to advance the trade in Empire products and in appropriate cases issue reports and monographs which are published by the Institute. At the beginning of the present year they were seven in number, dealing respectively with Timbers, Silk Production, Vegetable Fibres, Oils and Oilseeds,

Tanning Materials, Hides and Skins, and Essential Oils and Resins.

The Advisory Council recently reviewed the work of the Committees with the object of effecting any changes that appeared desirable, and of making arrangements to keep abreast of new developments. The Council finally approved a revision of the membership of certain Committees and made the following recommendations which have been accepted by the Director and put into effect :

(*a*) The title of Advisory Technical Committee should be superseded by that of Consultative Committee.

(*b*) In view of the desirability of devoting special attention to resins and gums produced in Empire countries the study of resins should be removed from the purview of the Essential Oils and Resins Committee and referred to a new Committee dealing with Gums and Resins.

(*c*) On account of the growing importance of the production and use of insecticide materials of vegetable origin (e.g. derris, pyrethrum, nicotine) in British countries, and the increasing work on the materials being done in the United Kingdom and in Empire and foreign countries, a Consultative Committee dealing with the problems concerning these materials should be appointed.

(*d*) Consultative Committees should be invited to consider the preparation of additional monographs on the subject of their enquiries.

(*e*) With the concurrence of the Chairman, Mr. Norton Breton, the Silk Production Committee should be dissolved, since the Committee were unanimous that in the existing state of the raw silk market there was no likelihood of a new silk industry being successfully developed in any British overseas country at the present time. The aim of this Committee had been to develop sericulture in Empire countries, and this task had involved the organisation of silk-raising experiments in all countries of the Empire possessing suitable climatic and other conditions and carrying out practical reeling, throwing, and weaving trials in the factories of members with the silk produced. The Committee's work culminated in the establishment of the Cyprus Silk Filature at Yeroskipos in 1926 and the official visit of the Chairman in 1929-30 to East and South Africa to report on the commercial possibilities of silk-raising

in those countries. Unhappily, the unexpected and phenomenal fall in the price of raw silk which occurred subsequently and from which no recovery has been made, had rendered silk production an economic impossibility in both areas, and, under present conditions, there seemed no possibility of establishing new silk industries in Empire countries. With much regret the Committee has therefore been dissolved.

The Advisory Council and Consultative Committees now working in association with the Plant and Animal Products Department, with their respective Chairmen, are:

Advisory Council.—Chairman, Sir Frank Stockdale, K.C.M.G., C.B.E. (Agricultural Adviser, Colonial Office).

Consultative Committees.

Timbers.—Chairman, James P. Fraser (James P. Fraser & Co.).

Vegetable Fibres.—Chairman, Alfred Wigglesworth (Wigglesworth & Co., Ltd.).

Oils and Oilseeds.—Chairman, E. R. Bolton, F.I.C., M.I.Chem.E. (Consulting Technical Chemist).

Sub-Committee on Tung Oil.—Chairman, E. R. Bolton.

Tanning Materials.—Chairman, Dorothy Jordan Lloyd, M.A., D.Sc., F.I.C. (Director, British Leather Manufacturers' Research Association).

Hides and Skins.—Chairman, Dr. D. Jordan Lloyd.

Essential Oils.—Chairman, P. C. C. Isherwood, O.B.E., Ph.D., F.I.C. (W. J. Bush & Co., Ltd.).

Gums and Resins.—Chairman, A. J. Gibson (Special Officer, Lac Inquiry, London).

Insecticide Materials of Vegetable Origin.—Chairman, H. A. Tempany, C.B.E., D.Sc., F.I.C. (Assistant Agricultural Adviser, Colonial Office).

The following statements indicate briefly the more important work of the Committees of the Plant and Animal Products Department.

Consultative Committee on Timbers

This Committee is engaged on a systematic programme of work with a view to the development of the trade in Empire timbers which, apart from a restricted number of established woods, were almost unknown in this country when the

Committee was appointed in 1916. Indeed, it is no exaggeration to say that the present position of the trade in Empire woods is in large measure due to the pioneer work of the Committee. The Committee took an important part in the organisation of the Empire Timber Exhibition held at the Imperial Institute in 1928. Special attention is now being paid to the question of grading Empire hardwoods intended for export to the United Kingdom, and to the possibilities of finding a market in this country for Newfoundland timbers. The publications of the Committee include a Descriptive List of Some Empire Timbers recommended by the Imperial Institute Advisory Committee on Timbers; Reports on British Columbia Timbers (I and II); Eastern Canadian Timbers; Nigerian Timbers (I, II, III, IV); New Zealand Timbers (I, II, III); Empire Timbers for Motor Bodies; Empire Timbers for Building and Decorative Purposes; Grading Rules and Standard Sizes for Empire Hardwoods (square-edged) intended for export to the United Kingdom, 1933; second edition 1937.

Consultative Committee on Vegetable Fibres

The work of this Committee which was established in 1926 has covered a wide range, but has been largely concerned with cordage fibres of Empire origin, especially sisal and phormium. Several series of immersion trials with marine cordage made from these fibres have been carried out under the auspices of the Committee and in collaboration with the Admiralty, and the results have been published in the BULLETIN OF THE IMPERIAL INSTITUTE and also issued in pamphlet form. The Committee is continuing to give consideration to the development of the markets for the fibres in question, and is in close relation with the Admiralty, the New Zealand Government, and the Board of Trustees for Sisal Research, all of which authorities are represented in the membership.

The Committee was also responsible for the compilation and issue in conjunction with the late Empire Marketing Board of monographs on "Indian (Sunn or Sann) Hemp" and on "Empire-Grown Sisal." Considerable assistance has also been rendered to the Indian agricultural authorities in regard to certain problems connected with the preparation of Sunn hemp for export.

Other matters dealt with have included the cultivation of flax in the United Kingdom, Kenya, and Australia; the cultivation of hemp (*Cannabis sativa*) in England; and a progress report on research on phormium undertaken by Professor A. T. King, of the University of Leeds, at the suggestion of the Imperial Institute, with a view to elucidating the cause of the erratic behaviour of this fibre in the form of yarn.

Consultative Committee on Oils and Oilseeds

This Committee, formed in 1926, is concerned with the extension of the use of vegetable oils and fats from Empire sources and of increasing the production within the Empire of vegetable oils required in British industry. Among the problems considered is that of the exploitation of the large areas under shea trees in British West Africa and the possibility of increasing the market for shea butter, especially for edible purposes. The improvement of the quality of Malayan copra and its marketing have also received attention. Through a Sub-Committee specially appointed for the purpose, action with a view to the production of Tung Oil in the Empire is in progress. A large number of experimental cultivation trials have been made in countries where conditions appeared suitable, and samples of resulting Empire-grown tung seed have been examined and found to yield satisfactory percentages of oil of excellent quality. The suitability of tung seed meal for feeding to animals has been investigated. The questions of machinery for decorticating the fruits and of methods of preparing the oil are now under review.

A memorandum, entitled "The Production of Tung Oil in the Empire," prepared by the Imperial Institute with the co-operation of the Sub-Committee on Tung Oil, has been issued as an Empire Marketing Board Publication.

Consultative Committee on Tanning Materials

Appointed in 1926 the Committee has been principally engaged on examining the needs of the tanning industry in the United Kingdom with respect to the supply of tanstuffs. The possibilities of replacing tanning materials at present imported from foreign sources with materials grown in Empire countries have received attention, and cultivation experiments in

co-operation with appropriate authorities have been initiated. Various tanstuffs of local use in overseas countries have been investigated with a view to their application in the United Kingdom. In this category are the sant pods of the Sudan and the many materials employed in the tanning industry in India. Investigations in relation to the most economically suitable varieties of wattle tree for cultivation under various conditions have been carried out, and the growing of sumach in South Africa has received attention. A general account of the principal tanning materials of Empire origin was published in a series of articles in this BULLETIN, with the approval of the Committee, and reprinted as a monograph in 1929.

Consultative Committee on Hides and Skins

This Committee was formed in 1927 at the request of the tanning trade in the United Kingdom. Its chief work has been to direct attention to the faults encountered in Empire hides and skins as they reach the world's markets, and to advise as to the correct methods of preparation to be employed. Empire countries have submitted consignments of hides and skins from particular districts or of particular breeds for investigation, including working trials in the tannery, and reports have been furnished as to quality, commercial value, and the lines on which improvement might be effected. In 1933 the Committee prepared a report on "The Collection of Reptile Skins for Commercial Purposes," and in 1934 the first exhibition of reptile skins was held at the Imperial Institute in collaboration with the Committee. At the instance of the Committee, who drew up a scheme of experiments, the subject of "blister" and the drying of East African hides was investigated. The drying experiments were conducted in Kenya, and the hides, numbering 1,000, were examined and tanned in the United Kingdom. The report, entitled "The Drying of East African Hides," was published in 1934. A monograph on "The Preparation of Empire Hides and Skins" has recently been issued (November 1937) in connection with the Committee's efforts to raise the standard of preparation in hides and skins from Empire sources.

Consultative Committee on Essential Oils

In the form in which it was originally constituted in 1928, this Committee has dealt with many questions relating to the

development of Empire resources of essential oils and resins, and their utilisation in British industry. Special consideration has been given to the possibilities of promoting the production within the Empire of essential oils such as geranium, lavender, and peppermint, and associated products, as for example, camphor, which are largely or entirely derived from foreign countries, and much useful work has been accomplished in this direction. The Committee has also been concerned with the commercial utilisation of various oils hitherto unknown to the trade. Through the recommendations of its Sub-Committee on Lac a scheme of lac research in the United Kingdom was sanctioned by the Government of India in 1933, and most promising results have already been obtained under this scheme. As already mentioned, it has recently been decided that the subject of resins with the addition of gums would more usefully form the subject of a separate Committee, which has now been appointed.

Consultative Committee on Gums and Resins

Arrangements have been made for this Committee to hold its first meeting early in 1938.

Consultative Committee on Insecticide Materials of Vegetable Origin

This recently-formed Committee has held one meeting, when, amongst other matters dealt with, a Sub-Committee was appointed to consider the preparation of a monograph on insecticides of vegetable origin. It is provisionally proposed that after introductory sections, each of the principal materials, such as derris, cube, pyrethrum, nicotine, etc., shall be considered separately, dealing with such questions as the country of origin, botanical relationships, toxic constituents, uses, existing sources of supply, production, trade, marketing, and so on. Technical departments overseas are being invited to assist in providing information on many of the points to be discussed. Certain matters of more scientific import, such as the application of selection methods to the improvement of the plants, and methods of evaluating the products, both chemical and biological, will be dealt with in appendixes.

Mineral Resources Department

The system of having, in addition to an Advisory Council, a number of technical committees each dealing with a group of minerals or metals was initiated in 1926 when the Imperial Mineral Resources Bureau was amalgamated with the Mineral Department of the Institute.

Towards the end of 1936 the Advisory Council on Minerals decided, for the convenience of the Department and in order to secure that each committee should cover a wider range of minerals and metals, to reorganise the fifteen Advisory Technical Committees on Minerals then in existence, and to reduce their number to seven. This coalescing of committees necessarily brought in its train reduction of the total membership. The membership is drawn from all branches of trade, science, and industry which are interested in the occurrence or utilisation of minerals, as well as from Official Departments. The Advisory Council and Consultative Committees now working in association with the Mineral Resources Department are as follows:

Advisory Council.—Chairman, Sir Wm. Larke, K.B.E. (British Iron and Steel Federation).

Consultative Committees.

Mining Law.—Chairman, W. Forster Brown, M.Inst.C.E., M.I.M.E., F.S.I. (Forster Brown & Rees).

Precious Metals.—Chairman, J. G. Lawn, C.B.E., D.Sc. (Eng.), A.R.S.M., M.Inst.M.M. (Johannesburg Consolidated Investment Co., Ltd.).

Base Metals.—Chairman, Wm. Cullen, LL.D., M.Inst.M.M. (Imperial Chemical Industries, Ltd.).

Coal and Petroleum.—Chairman, Prof. K. Neville Moss, O.B.E., M.Sc., M.Inst.C.E., M.I.Min.E. (University of Birmingham).

Iron and Ferro-Alloy Metals.—Chairman, Herbert K. Scott, J.P., M.Inst.M.M. (Mining Consultant).

Chemical Industries.—Chairman, A. E. Dunstan, D.Sc., F.I.C. (Anglo-Iranian Oil Co., Ltd.).

Miscellaneous Minerals.—Chairman, G. H. Tipper, M.A., M.Inst.M.M. (Minerals Adviser to the High Commissioner for India).

The Consultative Committees of the Mineral Resources Department perform two main functions. In the first place

each serves as a panel of advisers in connection with the preparation, by members of the Institute staff, of those mineral monographs coming within its purview. There are more than fifty such monographs, and it is a function of the Committees to advise as to the order in which periodical revision should be put in hand, to suggest any alteration they may deem advisable in the scope and matter to be included, to consider the draft monograph when complete and suggest amendments, and, finally, to approve each issue before publication. They also advise as to the preparation of entirely new monographs, and, if necessary, the discontinuance of old ones.

In the second place the members of the Consultative Committees, both individually and collectively, place their specialised knowledge of certain aspects of the mineral industry at the disposal of the Institute and in this way are often of considerable assistance in dealing with the enquiry work which has grown considerably in volume during recent years.

Recent activities of the several Committees have been as follows :—

Mining Law Technical Committee

This Committee has given much consideration recently to questions submitted to the Institute by the Dominions Office, in connection with the proposed granting of extensive concessions to prospect for and mine minerals in Labrador, and also to the subject of smelter fume indemnity legislation for Northern Rhodesia. During 1936 it assisted in the production of an Institute monograph entitled "Mining Royalties and Rents in the British Empire." Earlier publications issued under the auspices of this Committee include 17 volumes dealing with the mining laws in force in different parts of the Empire.

Consultative Committee on Precious Metals

The subjects covered by this Committee include gold, silver, the metals of the platinum group, and quicksilver. Recent activities of the Committee have included the consideration and approval for publication of a monograph on platinum and allied metals.

Consultative Committee on Base Metals

The subjects coming within the purview of this Committee include aluminium, antimony, arsenic, beryllium, bismuth, cadmium, copper, lead, magnesium, tin, and zinc. The Committee has under review a new edition of the monograph on tin, upon which considerable progress has been made. It has also recommended that the monographs on aluminium, magnesium, and copper should be revised, and considerable work has already been done on the first two subjects.

Consultative Committee on Coal and Petroleum

This Committee, which deals with coal, petroleum, natural gas, asphalt, oil shale, and peat, is actively engaged in connection with the revision of the monograph on coal upon which considerable progress has been made, and several members have undertaken to prepare sections dealing with certain aspects of coal technology.

Consultative Committee on Iron and Ferro-Alloy Metals

The metals dealt with by this Committee include chromium, cobalt, iron, manganese, molybdenum, nickel, columbium, tantalum, tungsten, and vanadium. The Committee has recently considered and approved for publication a new edition of the monograph on manganese ores. Revised editions of the monographs on vanadium and chromium are in preparation, and the Committee has recommended that the revision of the document on iron ore should be undertaken next.

Consultative Committee on Chemical Industries

This Committee deals with barium, borates, bromine, calcium, fluorspar, iodine, lithium, nitrates, potash, phosphates, pyrites, sulphur, and strontium. During the past year it has considered and approved for publication new editions of the monographs on barium minerals and strontium minerals. The Committee has also suggested that as and when other work permits the monographs on phosphates and potash should be revised and a new volume prepared on titanium minerals.

Consultative Committee on Miscellaneous Minerals

The subjects coming within the purview of this Committee include abrasives, asbestos, china-clay, diatomaceous earth, felspar, fuller's earth, graphite, gypsum, mica, magnesite, and talc. During the past year the Committee has considered and approved the issue of a new edition of the monograph on asbestos. It has also recommended that the monograph on mica should be the next to undergo revision.

NOTES

The Exhibition Galleries.—In keeping with the administrative separation of Burma from India which took place on April 1, 1937, a separate Court has been formed for Burma in the Exhibition Galleries. The new Burma Court is situated between the Indian and Ceylon Courts and close to the Malayan Court, and occupies a prominent position giving access to the Exhibition Pavilion. An up-to-date representation of each of Burma's important industries is in process of being assembled and in the meantime the Court has been temporarily furnished with an attractive display of Burmese handicrafts, illuminated dioramas, sketches, enlarged photographs and examples of economic products. The dioramas illustrate (1) the petroleum oil field at Yenangyaung, (2) a scene in a Burmese teak forest, (3) the harvesting of rice, and (4) the Port of Rangoon. The examples of handicrafts comprise statuettes in silver, ivory and bronze; richly embossed silver dishes and bowls; lacquer ware in great variety; a carved teak overmantel, a teak statuette representing two Burmans boxing, a teak model of a monastery and an alabaster figure of Buddha. Chief amongst the economic exhibits is one illustrating the story of the great silver-lead-zinc mine at Bawdwin, already referred to in this BULLETIN, 1937, **35**, 185.

The formation of this Burma Court and the segregation of Burmese exhibits from those of India have provided an opportunity for the rearrangement of the Indian Court, and the general forestry and mineral exhibits have been rearranged to conform to the modern story method of display.

Specimens showing stages in the preparation of mica powder, prepared in the United Kingdom from Indian scrap mica, for the decoration of wallpaper and ceiling paper, have been presented by Wall Paper Manufacturers Ltd. and added to the mica and micanite exhibit in the Indian Court.

Further consignments of exhibits from Travancore, comprising coir fibre and pandanus leaf manufactures, and examples

of various other handicrafts, have been received for the Travancore Court.

In the Hong Kong Court, by means of numerous photographs and a map, a picture travelogue of Hong Kong and the New Territories has been arranged. This takes the visitor to many interesting and picturesque spots in Victoria, up the Peak and about the Island, and also further afield across the water to Kowloon and the New Territories.

An attractive picture representing two Nellore bulls with cart and Tamil boy, painted in oils by Mr. David Paynter and lent by Lady Burrows, is now on exhibition in the Ceylon Court.

An up-to-date map of Northern Rhodesia received from the Commissioner for Lands, Mines and Surveys at Livingstone, has been placed on exhibition in the Court.

To the Kenya timber exhibit have been added specimens of flooring blocks of "musharagi" (Kenya olive) received from the East Africa Timber Co-operative Society, Ltd., through Messrs. Anthony Gibbs and Sons; also a collection of 23 hand specimens of Kenya timbers received from the Conservator of Forests.

A model of a pyrethrum plant in flower has been added to the Kenya pyrethrum exhibit, also dummy tins of proprietary insecticides containing pyrethrum.

Samples of maize manufactures presented by Messrs. Brown and Polson, Ltd., have been added to the East African maize exhibit, which has now been rearranged to tell a story under the caption "Maize—A Food for Man and Animals."

An excellent model of a coffee spray, showing the flowers, the unripe fruits and the ripe coffee cherries, has been made in Kenya and generously presented by the Coffee Board of Kenya. The whole coffee exhibit has been rearranged to tell the story of East African coffee "From Seed-bed to Coffee Cup."

An accurate wax model of the passion-fruit plant in flower and fruit, donated to the Court by the Passion Fruit Board through the Kenya Farmers' Association (Co-operative), Ltd., is being made to serve as an introduction to an exhibit to passion fruit products.

A tung oil exhibit has been added to the East African Court, also an exhibit of essential oils, the latter comprising oils derived from geranium, peppermint, lemongrass, lavender and *Cymbopogon afronardus*, together with various commodities in the composition of which these oils enter.

To the photographs in this Court have been added enlargements showing native methods of grain storage, prepared from negatives kindly loaned by Mr. H. Gillman, Agricultural Officer, Tanganyika.

Maps of Zanzibar and Pemba showing the clove areas and the distribution of other crops, sent by the Agricultural Officer, i/c Government Plantations, have been received; also a sample of clove stems from The Clove Growers' Association. The Zanzibar clove exhibit has been rearranged, and the sequence of exhibits and photographs now traces the story of cloves through the stages of cultivation, harvesting, and the preparation of cloves for export, and is continued to show the products of the essential oil obtained by the distillation of cloves.

Travelogues have been arranged with photographs of Tanganyika, Uganda and the Sudan under the headings "Through Tanganyika," "A Trip Round Uganda," and "A Journey Up the White Nile."

To the gold exhibit in the South African Court (described in the last number of this BULLETIN, 1937, **35**, 353) has been added, through the courtesy of Prof. C. S. Gibson, F.R.S., a series of specimens showing one of the latest applications of gold, viz. the deposition of pure gold films on glass and similar surfaces from solutions of organic compounds of gold. The films by reflected light have all the mirror-like brilliance of burnished gold and yet are so thin as to be transparent. Of particular interest is a 6 in. clock-glass so treated, which has been mounted and framed as a convex mirror. The thickness of the film is 0·004 mm., and the value of the deposited gold is estimated at one-eighth of a penny. Once the starting material is available, the films are more easily produced than those of silver and are much more chemically inert. The process may in the future have a number of scientific applications.

Also in the South African Court, the complete overhaul of the diamond exhibit and the incorporation of a number of new specimens has added considerable popular appeal to an already interesting display. The story of diamond mining from the "blue ground" to the final concentrates and the separation of the diamonds on the "grease tables" is told by a sequence of photographs and specimens kindly furnished by De Beers Consolidated Mines, Ltd.

A collateral, if simpler, story of the winning of diamonds from alluvial deposits, is told in a similar manner, and includes an actual diamond still embedded in its natural conglomerate. The latter specimen is the personal gift of Sir Ernest Oppenheimer and Mr. H. T. Dickinson, of De Beers.

In another part of the display the little-known art of diamond cutting is elucidated—the various machines and appliances are shown by photographs, while the progressive stages in the facetting of a brilliant are demonstrated by large models cut in rock crystal. Other styles of cutting, such as the "rose," the "step-cut," the "scissor-cut," etc., are also

shown. A topical note in this Coronation year is struck by a model of the Cullinan diamond and the gems into which it was cut and which now form part of the Crown Regalia.

Through the kindness of Messrs. L. M. Van Moppes and Sons and a number of co-operating firms, the many industrial uses of the diamond for grinding-wheel dressing, rock-core drilling, wire drawing and so forth, are demonstrated by panels on which are mounted typical diamond tools, photographs showing the way that they are used and examples of the kind of work which they produce.

The exhibits in the Fiji Court have recently undergone rearrangement and a show-case is now devoted to a display illustrating the Fiji sugar industry. The samples for this exhibit were received from the Colonial Sugar Refining Co., Ltd., of Sydney, through the courtesy of Sir Philip Goldfinch, K.B.E. The samples and the associated photographs trace the story of sugar from the cane through the various processes of crushing the cane, boiling and concentrating the juice, and refining the sugar crystals, down to the finished sugars and by-products. A new diorama to form an introduction to this exhibit is under construction in the studio and is nearing completion.

From negatives kindly loaned by Mr. H. Macluskie, Director of Agriculture, British Guiana, a series of enlargements has been made to illustrate the exhibit of St. Vincent arrowroot, which has been arranged in the West Indies Court under the caption "Arrowroot—a Digestive Starch."

The West Indies Court has also received an important addition in a series of 42 sepia enlargements recently sent by the Government of Jamaica. These photographs are technically and artistically of a very high standard, and they are being arranged on screens, with a map, to form a travelogue of the island.

Colonial Visitors.—The following is a list of officers on home leave from the Colonies who have visited the Institute during the three months August to October 1937.

AUGUST 1937

S. M. BRODERICK, African Assistant Director of Education, Sierra Leone.
C. L. BRUTON, O.B.E., Provincial Commissioner, Uganda.
C. M. HARRIS, Assistant Conservator of Forests, Uganda.
W. E. M. LOGAN, Assistant Conservator of Forests, Gold Coast.
H. B. PIDDUCK, Assistant Agricultural Officer, Dominica.
L. W. RAYMOND, Government Chemist, Department of Agriculture, Zanzibar.
E. H. G. SMITH, Botanist, Department of Agriculture, Nigeria.
H. E. WALKER, Deputy Director of Public Works, Nigeria.

SEPTEMBER 1937

A. C. BARNES, C.M.G., Director of Agriculture and Island Chemist, Jamaica.
A. T. BENNETTS, V.D., Warden of Mines, Pahang, Federated Malay States.

J. A. BEVAN, Inspector of Mines and Labour, Cyprus.
D. L. BLUNT, Director of Agriculture, Nyasaland.
Lt.-Gen. Sir CHARLES BONHAM-CARTER, K.C.B., C.M.G., D.S.O., Governor, Malta.
A. R. BURNETT-HURST, Government Statistician, Southern Rhodesia.
J. B. CLEMENTS, Conservator of Forests, Nyasaland.
M. T. DAWE, O.B.E., Director of Agriculture and Forests, Palestine.
Sir WILFRED JACKSON, K.C.M.G., Governor, British Guiana.
J. DE LEON, Agricultural Department, Palestine.
Captain R. C. MARSHALL, Conservator of Forests, Gold Coast.
Sir GEOFFREY NORTHCOTE, K.C.M.G., Governor, Hong Kong.
Captain H. R. OKE, M.C., Colonial Secretary, Gambia.
C. C. WOOLLEY, C.M.G., O.B.E., M.C., Colonial Secretary, Jamaica.

OCTOBER 1937

A. K. BRIANT, Agricultural Superintendent, St. Vincent.
A. B. CORMACK, Department of Agriculture, Nyasaland.
T. R. HAYES, Agricultural Officer, Uganda.
Captain W. W. HENDERSON, Chief Veterinary Officer, Nigeria.
A. G. HILL, Director, Agricultural Research Institute, Amani, Tanganyika Territory.
C. W. LYNN, Agricultural Superintendent, Gold Coast.
Captain J. R. MACKIE, Director of Agriculture, Nigeria.
E. B. MARTYN, Botanist and Mycologist, British Guiana.
J. T. MOON, Agricultural Officer, Kenya.
F. D. RUGMAN, Financial Secretary, The Sudan.
A. H. SAVILE, District Agricultural Officer, Tanganyika Territory.
H. SERVICE, Geologist, Geological Survey, Gold Coast.
A. S. SMALL, C.M.G., Colonial Secretary, Straits Settlements.
R. J. M. SWYNNERTON, Agricultural Officer, Tanganyika Territory.
F. W. TOOVEY, Botanist, Department of Agriculture, Nigeria.
Dr. J. D. TOTHILL, Director of Agriculture, Uganda.
Sir A. DE V. WADE, C.M.G., O.B.E., Colonial Secretary, Kenya.

All Dominion and Colonial officers, as well as private residents overseas, who may be visiting London are cordially invited to come to the Institute to see our Exhibition Galleries, and to discuss scientific and technical problems in which they may be interested.

Hides and Skins.—A monograph was issued on November 5th, 1937, by the Plant and Animal Products Department of the Imperial Institute, entitled *The Preparation of Empire Hides and Skins*, edited by J. R. Furlong, Ph.D. (Würz.), A.I.C. (Royal 8vo, boards, 126 pp., illustrated). It is obtainable from the Imperial Institute, London, S.W.7, price 3*s*. 6*d*., by post 3*s*. 10*d*.

Hides and skins, which are the raw materials of the tanning industry, are available in all parts of the world where the animals concerned exist, and the conditions under which they are produced and prepared for the tanner must of necessity vary very considerably. In some countries, where for religious reasons meat is not eaten, the hide represents the only valuable part of the dead animal and in consequence it is removed without regard to the carcass but with a view to preserving the full value of the hide. In meat-eating countries, on the other hand, the carcass is of primary importance, and in general little care is bestowed on avoiding damage to the hide.

An exception to this, however, is found in the large freezer works and certain abattoirs, where by organised manipulation a high standard of flaying and preserving is maintained. The bulk of the hides and skins reaching the world's markets are derived from slaughterings for food purposes, and the greater part of them suffer from damage in preparation, which could be avoided. This damage necessarily reduces the market value of the goods, and the annual loss, estimated at some millions sterling, is borne by the producers. Disease, insect pests and other causes contribute to a lowering of quality, but the principal causes are faulty flaying and curing.

In recent years systematic attempts have been made to improve the position, by research work on methods of preparation and by propaganda and the education of those concerned with production. It is a matter which has greatly concerned tanners in Europe and throughout the world, and the official departments engaged in animal husbandry in producing countries. Though some progress has been made, the need for more experimental work is recognised on all sides, and appropriate action is required to introduce the improved methods so far evolved.

The object of the Institute's monograph is to present in one volume such information as will be of service to all those concerned with the industry—farmer, dealer, tanner, veterinary officer or other scientific worker, and administrator—in their efforts to promote this work of improvement.

It describes the faults which are encountered in cattle hides and calf, sheep and goat skins as they arrive at the tannery, and correlates them with the stage in the production and preparation in which the damage has been occasioned, while features which constitute good quality from the point of view of the tanners' requirements are described. The faults include defects due to disease, insect pests, mechanical damage, flaying and unsatisfactory drying or preservation. Methods of preparation and handling are discussed in detail with special reference to the experimental work which has been carried out on the subject, and the correct methods to be employed are described.

The latter part of the monograph is devoted to a description of the production of hides and skins in the British Empire, consisting of an account of the industry, collection and marketing, methods of preparation in use, local investigations and general outlook in each country of the Empire. This part of the work was made possible by the co-operation of veterinary and other officers in overseas countries, who supplied the information in response to a questionnaire sent out by the Imperial Institute. In compiling the first part of the monograph, dealing with defects, experimental work and methods

of preparation, the assistance of the British Leather Manufacturers' Research Association and the United Tanners' Federation was obtained.

The Imperial Institute invites correspondence from those in the Empire interested in any way in this important subject.

Erratum.—Mr. W. W. Henderson, Director of Veterinary Services, Nigeria, has drawn attention to an error which has been introduced in editing the statement he furnished on the position of the hides and skins industry in Nigeria. In para. 2, p. 101, of the monograph it is stated that the investigation into the causes of the various blemishes shown in Nigerian skins and hides after tanning had been undertaken by the "Department of Agriculture." This should be the "Veterinary Department," which, Mr. Henderson points out, has been solely responsible for the work.

Experiments on the Packing of Passion Fruit Juice, II.—In the last number of this BULLETIN, 1937, **35**, 358, a progress report was published on experiments conducted at the Fruit and Vegetable Preservation Research Station of the University of Bristol at Campden, Gloucestershire, with a view to ascertaining the best method of packing passion fruit juice. An examination of the material has now been made after twelve months' storage, and the following further report has been kindly furnished to the Imperial Institute by Mr. F. Hirst, M.Sc., A.R.C.S., the Director of the Station.

University of Bristol, Research Station, Campden, Glos.
Report on the Canning of Passion Fruit Juice

The experiments were carried out on both the raw juice and sweetened juice and in each case one part of the product was packed in open top cans, which were sterilised, and another part in beverage cans. In the latter case sodium benzoate was added as preservative. Control samples of all the products were packed in bottles.

After twelve months' storage the colour of the product from plain open top cans was distinctly brighter than that from bottles, but the use of lacquered cans gave a rather dull colour. In beverage cans the colour was slightly brighter than in the case of the bottled control. With regard to the flavour, the use of sodium benzoate as preservative imparted a perceptible flavour of this compound to the product. The flavour of the juice packed in open top cans was different from that of the controls in that the fruit esters were more easily detected by the palate, but it is difficult to say whether this would be considered an advantage or a disadvantage by

people accustomed to this fruit. It may be remarked that the sterilising process has the effect of increasing the viscosity of the juice, either raw or sweetened. This consequently reduces the tendency of the juice to separate into two layers.

In general it appears that the most satisfactory method of packing this product is in plain open top cans, sterilised by heat, but unwaxed beverage cans would, of course, answer the same purpose.

Roselle Fibre.—Roselle fibre is obtained from the stem of *Hibiscus Sabdariffa*, a large annual herb of the natural order *Malvaceae*. This plant is a native of the Old World tropics, but has been introduced into Australia, the West Indies and tropical America, and is now widely cultivated, though not on a very large scale.

In addition to its use as a fibre-plant, *H. Sabdariffa* is grown for the fleshy calyces of the flowers, which are used to some extent as a flavouring and colouring material, but chiefly for the preparation of a beverage known as " Roselle tea," or, in the Sudan, as " Kerkedeh."

For the purposes of fibre-production, however, special varieties of the plant are grown, and cultural methods are employed which do not favour flowering. As the formation of flowering and vegetative branches breaks up the continuity of the fibres of the main stem, thus reducing their value, the aim of cultivation is to obtain a tall, upright plant, with no lateral branches or flowers. This has been achieved in Java by sowing just before the rainy season, and allowing the plants to come up in a close stand. Flowering does not then take place until after the rains, which leaves about four or five months for vegetative growth, and the plants may still be harvested at the end of the rainy season before the flowering branches appear, having reached a height of up to 15 feet.

The extraction of the fibre is somewhat difficult, and is usually carried out by hand. It has been suggested that sisal machinery might be suitable for the purpose, but some retting process appears to be necessary to obtain a clean product.

Harvesting is usually by hand, the stems being cut a short distance above the ground. They are sometimes allowed to lie for a day or two before being stripped of their leaves and tied into bundles. Retting generally follows directly, though it is possible first to strip off the bast by hand, when the stems have just been harvested. This reduces the bulk of the material to be retted, but is only economically possible with very cheap labour. The retting process takes from about nine to twenty-six days, according to whether it is carried out in standing or running water. Retting in running water takes longer, but has the advantage of yielding a cleaner and

silkier product. When retting is complete, the bundles of fibre are peeled off, dried and bleached in the sun, and finally cleaned by brushing. Yields of fibre ranging from 1,000 to 1,800 lb. per acre have been recorded.

The fibre obtained is fine, strong and silky, and about 6 to 7 ft. long. It is readily spinnable, and acts as a useful substitute for jute, both for ropemaking and for making cloths and sacking. It is claimed that Roselle fibre is very resistant to the action of sea-water.

Apparently no country is at present producing Roselle fibre on a large scale, although it has been grown experimentally in such countries as Ceylon and the Philippine Islands, and is used by the natives of many countries where the plant grows wild. It has given promising results in the Netherlands East Indies, where the development of fibre cultivation has been under consideration with a view to providing raw material for the local manufacture of gunny bags to replace the imported article. The Imperial Institute was informed in February of this year that the Industrial Section of the Department of Economic Affairs in the Netherlands East Indies had perfected plans for developing the culture of Roselle fibre on an extensive scale. It is also understood that a factory for making the fibre into gunny bags is projected.

Indian Oils and Oilseeds.—The first detailed examination of Indian vegetable oils was undertaken in 1898 by Crossley and Le Sueur at the suggestion of the Imperial Institute, and the results obtained were published in the *Journal of the Society of Chemical Industry*, 1898, **17**, 989-994, and in the *Agricultural Ledger*, of India, in the following year. Further information relating to Indian oils was published by Hooper, Menon and others in the early years of the present century, while to the *Agricultural Ledger* for 1911-12 a résumé of the results available up to that date was contributed by Hooper, no less than 134 species being dealt with, although not all in complete detail. Since that year the subject has been continued by many workers, notably by Simonsen and his pupils at the Indian Forest Research Institute, Dehra Dun. Many reports on Indian oilseeds have also been published in this BULLETIN.

N. Brodie has done a useful service by collecting together the available information on Indian oils in a publication just issued as *Bulletin No.* 10 *of the Indian Industrial Research Bureau* (Delhi: Manager of Publications, 1937). For this compilation the author has drawn for his material not only on the papers which have appeared in the *Agricultural Ledger, Indian Forest Records*, the *Bulletin of the Imperial Institute*, and other scientific journals and books, but has also availed

himself of the records of the Government Test House and of the Harcourt Butler Technological Institute. There is a short introduction dealing with the methods of extracting and examining fixed oils and then follow the detailed accounts of the different oils, nearly 130 in number, arranged according to their nature, under the headings drying, semi-drying and non-drying oils. In the case of the more important oils, such as linseed, cottonseed, sesame, rape and mustard, ground-nut, castor and coconut, statistics of production in different countries are given, taken from the Statistical Year Book of the League of Nations for 1935-36, as well as figures relating to the area and yields in India, and to imports and exports.

Another publication on Indian oilseeds has recently been published under the title " Minor Forest Products of Chakrata, Dehra Dun, Saharanpur, etc., and Neighbouring Forest Districts, Part I, The Oil-bearing Seeds " (*Indian Forest Records, New Series, Chemistry*, 1936, I, No. 1, pp. 1-44.) This contains the available information collected at the Forest Research Institute, Dehra Dun, regarding the botany and distribution of the plants and the physical and chemical properties and probable commercial uses of oils, fats and oilcakes obtained from seeds growing in the above-mentioned districts. Dr. S. Krishna and Dr. S. V. Puntambekar are responsible for the chemical part of the work, whilst the botanical part has been compiled by M. B. Raizada. It is hoped by the authors that the information contained in this publication will not only be of service to the scientific worker, but will also be of use to the business man and so help to foster the growth of trade in these products.

Boron in Agriculture.—Much attention has been devoted in recent years to the minor elements in the soil and their influence on plant growth. An article dealing with many of these was published in this BULLETIN, 1936, 34, 212-219, under the title " Minor Mineral Fertiliser Materials," and reference to another, boron, is made below.

The effect of boron on plants is by no means comparable with that of ordinary manures. Its nature is rather that of a stimulant to healthy growth, and its absence or scarcity in the soil may be the cause of serious nutritional disorders in certain crops. Such disorders range from slight reductions of yield resulting from unhealthy growth to serious diseases with stunted root and stem formation, and breakdown of internal tissues leading ultimately to the death of the plant. The quantity of boron required for normal growth varies with different crops, but it is always extremely small, in spite of the important part which the element evidently plays in plant nutrition. In water cultures the optimum concentration is

usually less than one part of boron per million parts of nutrient solution, and the small quantities of the element contained naturally in most soils are, as a rule, amply sufficient for plant requirements. It will be seen then that boron treatment is applicable only to soils already deficient in the element, and is essentially a preventive measure against restricted growth and disease arising from malnutrition.

A state of boron deficiency may arise not only from actual shortage of the element in the soil, but partly also from conditions which influence its availability to plants. Thus, as a result of high alkalinity, high lime content, or drought conditions due either to low rainfall or to excessive drainage in sandy and gravelly soils, the proportion of boron available to plants may be greatly reduced. Such conditions will therefore aggravate the ill effects of boron shortage, and were formerly considered to be the direct cause of some of the deficiency diseases.

Only a limited number of crops have been shown to be susceptible to boron deficiency as it occurs in the soil, and of these beet has received most attention, partly owing to its relatively large boron requirements. In certain areas beet suffers from a physiological disease known as "heart rot," and it has been demonstrated that this condition can be prevented by applications of borax at the rate of about 30-40 lb. per acre, while much smaller quantities—of the order of about 10 lb. per acre—will greatly minimise the damage. Obviously, however, there can be no generalisation for any crop as to the quantity necessary to make good the deficiency, for this will depend entirely on local soil conditions.

Among other crops reported to have shown symptoms due to boron deficiency are mangolds, turnips, swedes, potatoes, certain leguminous crops and cereals, celery, cauliflowers, tobacco, apples, and citrus. In many of these instances investigations have not yet progressed very far and little detailed information is available.

The case of citrus is worthy of special mention, for, although the crop is known to be sensitive to an excess of boron, its susceptibility to a deficiency of the element under field conditions is a recent discovery. It has been found in Southern Rhodesia that the citrus malady known locally as "hard fruit" can to a large extent be controlled by soil applications of small quantities of borax. In a note on the subject published in the *Rhodesia Agricultural Journal*, 1937, **34**, 166, it is stated that the disease which causes a considerable annual loss in the Mazoe District is characterised by leaf-fall, with dying back of the young shoots in severe cases, and premature shedding of most of the fruits. The fruits which remain on the tree are malformed and dried out, showing gum pockets and patches of corky tissue. It is further stated that the disease

is associated with mature trees and that its development is aggravated by high temperature, low humidity, and soil conditions favouring rapid drainage.

The important influence which the soil texture and reaction have on disorders primarily due to boron deficiency has recently been demonstrated again in the case of the apple disease known as "internal cork." A paper on "The Boron Status of New Zealand Fruit Soils," by H. O. Askew, R. H. K. Thomson, and E. B. Kidson (*N.Z. J. Sci. Tech.*, 1937, **18**, 789-796), describes the latest work in that country correlating soil conditions with the incidence of internal cork, whilst another by C. G. Savage and H. Broadfoot (*Agric. Gaz. N.S.W.*, 1937, **48**, 387-390, 447-452), records the excellent results obtained with soil dressings of borax in controlling the disease in the Kentucky district of New South Wales.

When present in too high a concentration boron may have highly injurious effects on plants. The danger of excessive application was well illustrated in the United States some twenty years ago, when, owing to a shortage of potash during the War, new sources were being exploited for fertiliser purposes. Some of the material used proved to contain a high proportion of boron in the form of borax, and as a result crops not suffering from boron deficiency were receiving up to 90 lb. per acre of borax with the normal application of mixed fertiliser, and considerable damage was done. More recently there have also been a number of cases of injury in the United States due to excessive amounts of boron salts contained in irrigation waters (*Tech. Bull. No.* 448, 1935, *U.S. Dept. Agric.*).

It will be seen, then, that where boron is added to the soil to make good any deficiency, extreme precaution must be taken against the use of quantities in excess of actual requirements. As regards the application itself, both the method employed and the amount of material used will depend entirely on local soil conditions, and this aspect of the question is therefore clearly one on which the assistance of local Agricultural Departments should be sought.

The literature on the subject of boron application is somewhat scattered, but a detailed summary of the work is given in "Boron in Agriculture," by R. W. G. Dennis and D. G. O'Brien (*Res. Bull. No.* 5, September 1937, *W. Scot. Agric. Coll.*). Recent developments in the work are also summarised in an article by R. W. G. Dennis entitled "Boron in Plant Life" (*Fertil. Feed. St. J.*, 1937, **22**, Nos. 18-21). This article has since been reprinted for distribution by the Boron Agricultural Bureau in London.

Fertiliser from Rock Phosphate.—Amorphous rock phosphate of variable composition, such as that occurring in

Tennessee, Florida, North Africa, etc. can be employed directly as a fertiliser. It has, however, the disadvantage of being only slowly available to plants, especially on some types of soil, and it often contains a small amount (up to 3 per cent.) of fluorine, an undesirable addition to the soil, and one which is believed to lower the solubility of the phosphate.

For some time it has been known that when finely ground rock phosphate is heated in an oxidising atmosphere in the presence of sufficient silica and water vapour, a very large proportion of the fluorine can be volatilised from the material. When the product is quickly cooled, the phosphate is nearly all readily available as plant food.

Recently reported results of small-scale tests and of trials on a semi-works scale have shown that rapid defluorination of fused rock phosphate can be brought about at temperatures 50° to 170° C. above the melting point of the phosphate, contact with water vapour, conveniently supplied by the combustion of oil fuels, being essential ("Fertiliser from Rock Phosphate," by H. A. Curtis, R. L. Copson, E. H. Brown, and G. R. Pole, *Industr. Engng. Chem.*, *Industr. Ed.*, 1937, **29**, 766-770). No addition of silica to that present in the phosphate was required, and products containing approximately 0·1 per cent. fluorine, 30 per cent. total phosphoric acid (P_2O_5), and 26 per cent. phosphoric acid soluble in ammonium citrate solution, were obtained.

In the semi-works-scale trials, three types of furnaces were employed. In all cases the silica refractories used were badly attacked by the molten phosphate, the attack being considerably less severe in a hearth furnace than in either a rotary kiln or a converter furnace.

It is considered that if the refractory problem can be solved, either by the use of more suitable material or by improvement in furnace design, it is probable that available phosphate, practically free from fluorine, can be produced commercially from rock phosphate by fusion and treatment with water vapour.

Magnesium Sulphate as an Insect Poison.—Many of the well-known and widely used insecticides contain arsenic in some form and therefore suffer from the great drawback of being extremely poisonous to man, domestic animals, and birds. Preliminary tests have recently shown that poison baits containing 20-25 per cent. magnesium sulphate, 60-65 per cent. bran, 15 per cent. molasses, and enough water to moisten, are as effective against grasshoppers as similar baits with 5 per cent. arsenic ("Magnesium Sulphate—A New Insecticide," by H. W. Frings and M. S. Frings, *Science*, 1937,

85, 428). Such baits are, of course, harmless to vertebrate animals and are also cheaper than the arsenic baits.

It is suggested by the authors that magnesium sulphate may be an insecticide of value in solution as a spray, as it appears to be fatal to mandibulate insects, while its ready solubility in water would render it easily removable from fruits and vegetables, an additional advantage over arsenic compounds.

Asbestos.—The latest of the numerous mineral monographs issued by the Mineral Resources Department and the third to make its appearance during the present year, is one on *Asbestos*, by G. E. Howling, B.Sc. (Lond.) (Royal 8vo, boards, 88 pp.) It is obtainable from the Imperial Institute, price 2*s*., by post 2*s*. 3*d*.

This publication, which was issued on November 1, consists principally of a survey of the world resources of asbestos, but it also contains a large amount of information of a more general character and deals comprehensively with dressing and grading, uses, manufactured products, marketing, and the statistics of asbestos production and trade.

Asbestos, which is commercially one of the most important of the non-metallic minerals, not only plays a very important part in the conservation of heat in boilers, pipes, ovens, etc., but also contributes materially to the comfort of mankind by insulating the distracting noises of modern life. For this purpose it is employed in ships, buildings, railway carriages, and tunnels. It is also an efficient electrical insulator in certain types of cable.

The bulk of the consumption, however, goes into asbestos-cement building products and pipes, but this industry makes use mainly of the shorter fibres. Large quantities of asbestos are also used in making motor car brake linings and in packings, gaskets and other products where fibres of animal or vegetable origin would not stand up to the heat and might involve a a risk of fire.

The longer fibres are spun and woven into yarn and tape or braided into rope in much the same way as any other fibre. Textiles manufactured from the yarn include fireproof theatre-curtains, clothing, gloves, blankets, and mail-bags.

Among the hundreds of other uses to which the several varieties of asbestos are put are the filtration of beer, wine, dilute acids and other chemicals, the manufacture of panels for electrical switchgear, paint, moulding compounds, and even wadding for gas masks.

The principal asbestos-producing countries of the world are Canada, the Soviet Union, Southern Rhodesia, the Union of South Africa and Cyprus, so that the British Empire is

very well placed as regards supplies of this important raw material. There are other deposits of good quality asbestos in Swaziland, Australia, India, New Zealand, and Newfoundland, and less important varieties occur in Kenya, Nyasaland, Tanganyika, Uganda, and Bechuanaland. Canada is by far the most important asbestos producer in the world, though the Union of South Africa possesses the only commercial deposits of two of the long-fibre varieties known as amosite and blue asbestos.

The chief consuming countries are the United States, the Soviet Union, the United Kingdom, Japan, Germany, Belgium, and France. The United States, which normally consumes about half the world's output, obtains most of its large requirements from Canada; the United Kingdom obtains practically all its asbestos from Empire producers; the U.S.S.R. consumes its own produce and has a large exportable surplus.

Those interested in the asbestos industry, either from the producing or manufacturing aspect, will find in this book a concise up-to-date and authoritative account of this interesting and unusual mineral.

Mineral Production of Sierra Leone.—The rapid rise of Sierra Leone as a mineral-producing country is borne out by the following notes taken from the *Report of the Geological and Mines Department for the year* 1936. General progress was made by the mining industry and record productions were returned once more for each of the minerals mined with the exception of platinum.

Gold.—The production of bullion in 1936 was 40,753 troy oz. with an estimated gold content of 37,956 fine oz. valued at £266,425, ten producers of over 1,000 oz. being responsible for approximately 83 per cent. of this output.

Maroc, Ltd., easily retained its position as the largest producer with an output of 15,883 oz. of bullion from 456,290 cu. yds. treated, which, however, is slightly less than the previous year. This company holds, in addition to stream rights, 106 sq. miles of ground under Exclusive Prospecting Licences, including the lode occurrences at Pujehun on which work is proceeding.

Messrs. Shamel Bros., a Syrian partnership, became the second largest producers with an output of 4,275 troy oz. of bullion, an increase of 2,700 oz. over the previous year. This is the only company working the very productive Sihun-Laminaia area of the Sanda Lokko Chiefdom of the Karene District, where gold was discovered by the Geological Survey in 1931.

Third in the list was the Sierra Leone Development Company, Ltd., with an output of 3,130 oz., which represented a

serious decrease in comparison with the previous year's production of 4,158 oz. of gold bullion. Work was again confined to within the company's Exclusive Prospecting Licence No. 177 in the Tonkolili area, with the exception of part of the Seli River near Bumbuna.

Most of the richer alluvial deposits have now been worked out and in all probability the peak has been reached in production from this source. Attention is now being given to the large rivers and in one case at least—the Pampana—the prospects appear to be good. A new concern, the Pampana Mining Co., carried out a good deal of prospecting work and their production amounted to 1,872 oz. Banka drilling has commenced on the Seli and Tibenko rivers.

Diamond.—The Sierra Leone Selection Trust, whose activities were described in the previous number of this BULLETIN (1937, **35**, 333-348), made continued progress during the year, production amounting to 616,200 carats.

Production, which is now entirely by mechanical pan plant, is mainly from the Oyie deposit near Konkwako, the Woyi at Koidu, the Gaiya, and the Danaeyi near Bagbema.

Iron Ore.—There was a big demand for Sierra Leone iron ore. The Marampa haematite deposits at Lunsar were mined by the Sierra Leone Development Co., Ltd., and 566,595 tons were exported from the loading port at Pepel. The erection at Marampa of a concentration plant to deal with powder ore, and the construction of further railway sidings at Pepel, which will be required in connection with iron ore concentration, commenced in this year. Work in connection with the stocking and shipping plant at Pepel for powder ore concentration was due to commence in 1937. A new haulage is also under construction to bring into exploitation the ore deposit on Ghafal Hill.

Prospecting continued in a small way on the Tonkolili haematite deposits on Simbili and Numbara Hills, both by core drilling and aditing. No further work has been undertaken in connection with the proposed railway, the survey for which has been completed.

Platinum.—The output of this metal fell from 750 oz. in 1935 to 484 oz. largely as a result of the cessation of activities by the United Africa Co., hitherto the largest producers. A few Africans continued production and an impetus was given to the industry by a considerable rise in price of the metal, but it is probable that the output will continue to fall year by year.

Chromite.—The Exclusive Prospecting Licence originally held by the African and Eastern Trade Corporation, Ltd., over the chromite deposits near Hangha in the Kenema District

was taken up once more, this time by the Sierra Leone Goldfields, Ltd.

The Canadian Steel Industry.—A recent mimeographed memorandum issued by the Bureau of Mines, Ottawa, gives a comprehensive yet concise account of the present position of the Canadian steel industry, which, during the last three or four years, has made an excellent recovery from the effects of trade depression ("What Canada is doing in Steel," by A. W. G. Wilson, *Bureau of Mines, Ottawa, Memorandum Series No.* 67, August 1937).

Most of the steel made in Canada is manufactured by the basic open-hearth process, and consists of low-carbon mild steel used for many purposes; some alloy steels are also made in open-hearth furnaces, chiefly for use in the automobile industry. A large quantity of steel is also made in electric furnaces, but this is mainly alloy or special steel required for various industrial purposes. The production of Bessemer steel in 1935 was only 645 tons, and there was no production of acid open-hearth steel.

No domestic iron ore for use in blast furnaces has been produced since 1924. The blast furnaces in Cape Breton obtain most of their ore from Newfoundland, only relatively small amounts of manganese-bearing ores being secured from other sources, usually from North Africa; blast furnaces in Ontario obtain their iron ore from the Lake Superior region. A small tonnage of specially processed ore, on which a provincial bounty will be paid, will probably be available in 1939, but this production will not do away with the necessity of importing large tonnages of various other grades of ore from present sources of supply. Hence the primary steel-producing industry of Canada is dependent, for most of its chief raw material, upon foreign sources of iron ore. Scrap metal for the steel industry is chiefly of local origin, but special grades of scrap are imported.

Most of the metallurgical coke used in Ontario is either imported as such from the United States or made in Ontario from coking coals from the same source. Local limestones are utilised for fluxing in Southern Ontario, but limestone from the United States is used at Sault Ste. Marie; Newfoundland limestone is used in Cape Breton. Most of the alloying elements used for special steels are imported in the form of ores, including those of manganese, chromium, and phosphorus. Ferro-silicon, ferro-manganese, high-carbon ferro-chrome, and ferro-phosphorus are made in Canada, as are also metallic cobalt, nickel, and copper; ferro-tungsten, ferro-titanium, ferro-vanadium, low carbon ferro-chrome, and other ferro alloys occasionally required in small quantities are imported, as is calcium molybdate.

The great growth of the mining industry in Canada has created a demand for many kinds of steel products, especially alloy steels; these latter are usually made largely from scrap metal in electric furnaces. Manganese steel castings of many kinds, including jaws for crushers, dies, stamp heads, balls, liners, are now made in Canada; drill steels and tool steels of varying characteristics are also made.

The Dominion Bureau of Statistics reports 38 firms in Canada engaged in the primary iron and steel industries. Three of these firms make not only pig iron but also a large variety of steel products, mainly from iron of their own production; one firm, which only operates seasonally, makes several kinds of pig iron. There are ten installed blast furnaces, of which six are in operation. The plants in operation include four plants making pig iron, 30 plants equipped with 81 steel furnaces making various kinds of steels, and 16 plants making rolled steel products. Ferro-alloys are made in three plants, apart from some low-grade by-product ferro-silicon derived from the electrothermic abrasive industry. No record of the number of forging units is available.

Columbium in the Steel Industry.—The rapid rise of columbite to a position of economic importance and the development of resources of this mineral have been fully dealt with in recent issues of this BULLETIN ("Production, Utilisation, and Marketing of Columbite-Tantalite Minerals, 1936, **34**, 348-353; "The Production of Columbite in Nigeria," 1937, **35**, 83). Now that the supply and demand are reaching equilibrium it is pertinent to review the uses and possible future demand for columbium together with its ore, columbite, and an article by J. H. G. Monypenny in the *Industrial Chemist*, 1937, **13**, 96-98, is of particular interest in this connection.

The advantages which have been claimed for the use of columbium in steel lie in two directions: (*a*) the prevention of intergranular corrosion in austenitic stainless steels of the "18-8," or similar type; (*b*) removal of air-hardening effects which are normally found, in greater or lesser degree, in the low-carbon high-chromium steels commonly known as "stainless irons."

It is common knowledge that the austenitic chromium-nickel stainless steels suffer from one particularly disconcerting drawback: unless they are properly heat-treated they are liable to suffer seriously from intergranular attack. Correct heat treatment consists in heating them to about 1,100° C. and cooling rapidly therefrom. If, however, they are cooled otherwise than rapidly from this temperature or are subsequently heated, even for a short period, to lower temperatures (particularly in the range 600° to 800° C.), their chemical

stability may be seriously undermined. Such heating is inevitable in the course of welding and in the past has necessitated proper heat-treatment after welding, often an inconvenient and sometimes an impracticable operation.

The major cause of this defect is believed to be due to the precipitation of an intergranular membrane of chromium carbide, owing to the limiting solubility of carbon in the steel being very low at a red heat. The chromium content of this carbide is very high and probably of the order of 90 per cent. The steel adjacent to this carbide layer is thus rendered deficient in chromium and rendered very susceptible to serious chemical attack.

Since the lowering of the carbon content of the steel to a value below its limiting solubility proves to be commercially impracticable, experimental work has been mainly directed to the addition of other carbide-forming metals which would result in the precipitation of a chromium-free carbide. The use of titanium for this purpose was first patented in 1929. If sufficient titanium is added to the steel (not less than about six times the latter's carbon content), troubles due to intergranular corrosion may be avoided. In particular, such a steel may be used satisfactorily in the welded condition without the need of subsequent heat-treatment.

Further experience showed, however, that, in cases where welds have to meet or cross, a variety of intergranular corrosion known as " weld decay " still occurred, owing to serious loss by oxidation of titanium from the first weld when reheated by the second one. It is claimed that columbium acts in a similar manner to titanium in eliminating intergranular corrosion, and, in addition, is much less readily oxidised in welding operations, so that it is easier, using a steel treated with columbium, to lay down weld metal which is itself free from weld decay. This use for columbium was patented in Germany in 1930 and in the United Kingdom in January 1933. A similar claim has been made for tantalum.

It is pointed out by J. H. G. Monypenny that such advantages as columbium may possess over titanium are likely to be found mainly, if not completely, in the steel used for the actual electrode or filler rod, where its use may make the laying down of weld metal which is itself " weld-decay-free " a more foolproof operation. He also points out that columbium is not unique in this respect as weld metal which is " weld-decay-free " can be laid down more readily from an electrode of the high-silicon type than one containing titanium.

Concern is expressed at the fact that the commercial production of ferro-columbium appears at present to be restricted to one concern in the United States. The cost of this 50 per cent. ferro-alloy is stated to be $2.50 per lb.

of contained columbium, a figure which is considerably higher than the corresponding costs of the titanium or the silicon alloys. The author wonders what supplies would be available in the case of a sudden demand, and, if such were to arise, what its effect might be on the cost of the alloy.

The other claim regarding the effect of columbium on the stainless irons has excited less comment. A large tonnage of stainless iron containing 12 to 14 per cent. of chromium is produced in this country, one of its main uses being for turbine blading. This material hardens to some extent on cooling freely in air from temperatures higher than about 800° C. The hardness so produced is readily removed by a simple tempering operation at about 700° C., and this, Monypenny states, has the advantage that the tempered article has better physical properties, particularly as regards yield-point and toughness, than would have been the case had no hardening effect been produced. It has been claimed that the addition of a suitable amount of titanium (five to six times the carbon content) or of columbium (eight to ten times the carbon content) prevents the material hardening on air-cooling from temperatures up to at least 1,000° C., and thus enables a softer product to be obtained. In Monypenny's opinion, however, it is doubtful whether the turbine manufacturers in this country would be impressed by the tensile or impact values of these specially treated stainless irons.

Summing up, Monypenny believes that the principal outlet for columbium will be in the manufacture of electrodes for use with " weld-decay-free " steels.

Utilisation of Waste Materials from the Production of Alumina.—Bauxite as mined usually contains considerable amounts of impurities, and the manufacture of alumina from it entails the production of large quantities of waste products. The possibility of the profitable utilisation of such waste material is, therefore, of considerable importance. The various uses to which these products have been put or for which they may prove suitable have recently been described (" Nutzbarmachung der Abfälle aus der Tonerde-Herstellung," by Dr. E. Herrmann, *Chemiker-Ztg.*, 1937, **61**, 493-6).

The waste products obtained as red sludge in the Bayer and the Deville-Péchiney chemical processes for the extraction of alumina from bauxite fall into two groups, according to the type of bauxite employed. The red sludge derived from European red bauxite contains a considerable amount of iron oxide and comparatively little silica, while that obtained from American white bauxite (including bauxites occurring in the United States and in British and Dutch Guiana) contains less

iron oxide and more silica. A distinction must be drawn between these two types of sludge.

European works employ mainly red bauxite as the raw material, and the red sludge obtained may, after drying, contain as much as 35 per cent. of iron, which renders the material of possible use as an iron ore. Its physical and chemical characteristics, however, cause very great difficulties in smelting, but these can be partly overcome by drying and briquetting the sludge, either alone or mixed with coal. This problem is still under investigation.

One of the important outlets for the red sludge is in gas purification. For this purpose only the residues from the dry (Deville-Péchiney) process are suitable, since the sludge from the Bayer process, in which the bauxite is treated with caustic soda, contains its iron in the form of ferric oxide, which has little absorptive power. In the dry process the bauxite is treated with soda together with some lime, so that the iron present is converted mainly into calcium and sodium ferrites. On subsequent treatment with water the ferrites decompose, giving a reactive iron hydroxide which has the power of absorbing hydrogen cyanide and hydrogen sulphide. The red sludge is used not only for the purification of coal-gas, but also in other industries such as the purification of hydrogen and carbon monoxide in the synthesis of methanol.

Another use for red sludge is in the manufacture of pigments. The sludge is dried, calcined at a low temperature, washed thoroughly with water to remove soluble matter, and re-dried. The pigment so obtained is not hygroscopic and is not attacked by sea water or by a number of acids and alkalis in the cold. The colour usually resembles that of red lead.

The red sludge may also be used to some extent in glass manufacture and in ceramics, to produce brown colours. In glass making, red sludge containing titanium compounds is particularly useful, as it gives a glass with a very fine clear brown shade.

Other possible uses on a small scale include the production of bricks, mortars, artificial stone, and other building materials, and of polishing powders and abrasives.

A bibliography including a number of references to patents is appended to the article.

The Search for Oil in the United Kingdom.—An account of the search for petroleum in Great Britain and of the Petroleum (Production) Act, 1934, has been given in this BULLETIN, 1936, **34**, 241. At present three companies, the D'Arcy Exploration Co., Ltd., the Anglo-American Oil Co., Ltd., and Steel Bros. & Co., Ltd., are actively drilling, either in England or Scotland, and a fourth, the Gulf Exploration

Co. (Great Britain), Ltd., is carrying out structural survey work. Together these companies have taken out prospecting licences covering roughly one-quarter of the total area of England.

The work done by the D'Arcy Exploration Co., which represents the interests of the Anglo-Iranian Oil Co., Ltd., and is by far the largest licence holder, has so far included, in addition to several shallow scout borings, the completion of two deep borings in the south of England, one at Portsdown, near Portsmouth, and the other at Henfield, in Sussex, as well as geophysical work with the torsion balance, magnetometer, and seismograph near Kelham in Lincolnshire.

The Portsdown boring began early in 1936 in the Chalk, at a site centrally placed on an anticlinal axis stretching from the vicinity of Southampton eastwards to that of Chichester. The intention was to ascertain whether the Kimmeridge and Oxford clays and the Lias shales were oil-bearing, and whether the Wealden, Purbeck, and Portland beds were sufficiently porous to act as oil-reservoirs. While this boring was in progress exploratory work in Dorset revealed that an outcrop of Corallian sand at Osmington Mills was heavily impregnated with oil and therefore hopes were raised of striking oil at the same horizon at Portsdown. The cores and cuttings, however, revealed that although there was slight evidence of oil in the Kimmeridge, Corallian, Oxford clay, and Kellaways beds, the Wealden and Portland formations were attenuated and unfavourable to oil accumulation. The hole, having proved to be dry, was finally abandoned at 6,556 ft., after passing through the Rhaetic into 16 ft. of Triassic sediments. Drilling had taken 320 days.

Meanwhile operations had begun in June 1936 on a subsidiary anticline to the north of the South Downs at Henfield. The hole, which commenced in Wealden clay, ended in strata understood to be of Carboniferous age, at a depth of 5,105 ft., without having encountered flows of oil, though tests on cuttings and cores showed the presence of oil at the same horizons as at Portsdown. A small gas accumulation containing 73 per cent. methane, 19 per cent. nitrogen, and 6 per cent. hydrogen was encountered at the top of the Great Oolite limestones.

The lack of success in both these wells was attributed to the low porosity and permeability of the Purbeck, Portland, and Corallian beds.

The drilling equipment from Portsdown was removed to test another anticline at Kingsclere near Newbury, Hants. This hole, which is still in progress, reached the Wealden formation at 440 ft., entered the Purbeck at 1,063 ft., the Portlandian at 1,567 ft., the Kimmeridge clay at 1,722 ft., the Corallian at 2,643 ft., the Oxford clay at 2,800 ft., and was

in the Middle Jurassic from 3,163 ft., but as yet no oil flows have been met with. Early in December the depth reached was 4,648 ft., and the bore was in the Lower Lias strata.

The same operating company is also putting down deep bores at Aislaby in Eskdale, near Whitby, Yorkshire, and at Cousland, a short distance south-east of Edinburgh.

The Aislaby well is intended as a test on the Eskdale anticlinal structure which has a meridional trend in Permian sediments underlying the Yorkshire Moors, and into which any possible oil from the Carboniferous may have passed. Work began here in July 1937, and the drill has now penetrated through the Lias, from a depth of 134 ft. to about 1,200 ft., through Liassic-Rhaetic strata to 1,333 ft., and thence into the Trias to a depth of 2,486 ft. At this depth operations were temporarily arrested by a drilling tool breakage. No oil has been found.

In Scotland drilling at Cousland is proceeding at a site located on the D'Arcy-Cousland anticlinal axis running north-east to south-west near Dalkeith. A well, known as the D'Arcy well, drilled in this neighbourhood by Messrs. S. Pearson & Sons, Ltd., immediately after the War, yielded 70 barrels of oil. The oil was found in the Oil Shale Group of the Lower Carboniferous, which formation is again being tested. The new well has now been drilled through the Lower Carboniferous Limestone, and at a depth of 1,151 ft. has been in the Oil Shale Group for more than 800 ft. No mention of any oil find has yet been made.

In addition to these major operations the D'Arcy company has also drilled shallower holes at Toxwell, near Worthing; Poxwell, near the oil-bearing sand occurrence at Osmington Mills, a boring which was abandoned at 1,666 ft., having reached the Great Oolite formation; and at Broad Bench in Kimmeridge Bay, where after being in the Corallian from 661 ft. the hole was abandoned at 942 ft. Negative results were obtained from all these drillings.

Still shallower borings have been made for stratigraphical information notably at Pevensey, Kingsclere, and Ham.

The Anglo-American Oil Co., Ltd., favoured a site in Sussex near Hellingly for its first deep well, and work was begun in June on the Grove Hill anticline, south of the Heathfield natural gas occurrence, and north of the oil-sand at Pevensey. A closure of this structure had been established. The Ashdown Sands were rapidly passed through down to 716 ft., then successively the Purbeck beds, the Portland sands from 1,020 ft. to 1,100 ft., which unfortunately proved to be impervious calcareous mudstones, the Kimmeridge, and the Corallian from 2,230 ft. to 2,414 ft. The last named, however, also had a negligible porosity, since it consisted of hard limestones and

marls, and the Oolitic limestones which were found between 2,600 ft. and 2,935 ft. were also dense and marly and had a low porosity. Drilling was continued into the Lias without success, and at 3,450 ft. the bit was believed to have entered the Carboniferous. Work ceased with a 9 in. diameter hole at 3,506 ft. because no suitable structures were anticipated in this system. The natural gas sand of Heathfield was not encountered in the bore.

The drilling equipment from this site was dismantled and transported to a location near Dalkeith in Scotland, only 100 yds. from the old D'Arcy well previously referred to. The licence to prospect in this area which covers 12 sq. miles had been transferred from a company registered as the Midlothian Petroleum Syndicate to the Anglo-American concern. Drilling began at the end of October of this year and has reached a depth of 1,770 ft. in the Lower Carboniferous.

The third firm now engaged in drilling operations in this country is Steel Bros. & Co., Ltd., who represent the joint interests of the Indo-Burma Petroleum Co., Ltd., the Attock Oil Co., Ltd., and the Pynima Development Co., Ltd. Two licences are held covering country on the Pennine anticlinorium, roughly from Nelson and Burnley southwards to Sheffield and Chapel-en-le-Frith. Interest here is centred in the Lower Carboniferous limestones, which, though only of moderate porosity, may carry oil in fissures and fault channels, as at the Hardstoft No. 1 well on the Duke of Devonshire's property, from which 3,682 tons of oil have been obtained.

The particular structure to be tested is the Edale anticline at Upper Booth, Derbyshire. Drilling commenced at the end of September and has gone down 400 ft. through Lower Carboniferous strata, so far without success.

In addition to the companies actively drilling, the Gulf Exploration Co. (Great Britain), Ltd., a subsidiary of the Gulf Oil Corporation of Pennsylvania, holds prospecting licences covering 1,124 sq. miles in Kent, Sussex, Wiltshire, and Dorset, and 153 sq. miles on the western side of the Yorkshire Moors.

Oil Prospecting in Uganda.—Indications of the existence of petroleum in Uganda (principally along the south-eastern shores of Lake Albert and in the Kisegi district between the head of the Ruwenzori Range and the lake) have been known to Europeans for more than a quarter of a century, and although many oil concessions have been granted since that filed by W. Brittlebank in 1913, no measure of commercial success has as yet been obtained.

In his report on the subject some years ago, E. J. Wayland, Director of the Geological Survey of Uganda, stated that the evidence of the seepages indicated that the oil had been formed

and accumulated in the Miocene and Pliocene sediments which rest upon a floor of crystalline rocks. These sediments consist in their lower divisions mainly of sandstones, and, in the upper, of a series of clays likely to give suitable closures. In addition, tilting movements and gentle folding have developed anticlinal structures parallel to the Albert valley which should favour the formation of oil-pools. Though no information as to the total thickness of this sedimentary cover is available, Wayland has suggested that oil is likely to be found, if at all, at a depth of 2,000 ft.

Recently attention has again been focussed on the possibility of finding oil in Uganda, and in May 1937 the Governor granted licences to search for oil in three areas adjacent to Lake Albert. The first area extends from Kibero on the Lake to Pakwach on the River Nile, the second stretches along the Lake in the flat hinterland of Kaiso, and the third is on the plain between the Semliki River and the Uganda rift scarp, the total area being in the vicinity of 1,384 sq. miles.

A portable drilling rig mounted upon a light motor truck has been shipped from the United Kingdom and operations are to begin in the area at the head of Lake Albert known as Parcel No. 1, and particularly around Butiaba. The equipment which is similar to that used for scout-boring in Britain, has been strengthened to go down to 1,000 ft.

The Gach-i-Qaraghuli Oilfield, Southern Iran.—The production of petroleum in Iran has for many years been derived largely from the Masjid-i-Sulaiman and Haft Kel fields in Khuzistan, and intensive surveys, both geological and geophysical, have revealed that the source-rock of these fields, the Asmari limestone, persists in a well-formed crest to the south-east for a distance of at least 125 miles.

In a recent article in the *Petroleum Times* (1937, **38**, 365), the development of a new field at Gach-i-Qaraghuli in this area of south-eastern Khuzistan is described. The seepage of gas from the Asmari limestone into the overlying Lower Fars strata gives rise to an assemblage of unusual secondary sulphate minerals with a characteristic colour and odour (the so-called *gaj-i-turush* or sour-gypsum), which mark the approximate line of the major anticline. Seismographical work delineated an axis closely coincident with that indicated by the geological work, and drilling commenced in 1926 with cable tools at two sites, No. 1 outfit reached 3,641 ft., and No. 2 struck high-pressure water at 4,228 ft., which so impeded progress that the work was stopped at 4,521 ft. In 1928 a third well was commenced which struck oil at 3,250 ft. under such high pressure that the tools were blown up the hole and jammed, and a fourth well, commenced in the next year,

struck a high pressure gas accumulation at 2,734 ft. showing a closed-in pressure of 1,990 lb.

It was then obvious that the pressure in the Gach-i-Qaraghuli field was beyond the capabilities of the drilling equipment available, and it was decided to shut down the wells until it was possible to furnish suitable rigs. By the end of 1936 great advances had been made in the technique of high-pressure drilling and it was decided to resume operations. Well No. 3 on the south-west flank of the structure was freed from the lost cable tools and deepened by the rotary method to 3,393 ft., where the hole, having penetrated 7 ft. into the Asmari limestone, struck a flow of oil approximating 33,000 barrels per day at a pressure of 850 lb. Two other wells on the north-east side met the oil-bearing rock at 3,368 ft. and 3,347 ft. respectively, and gave productions of 3,000 barrels and 33,000 barrels. The limits of the structure are now being surveyed by further drilling, which, it is hoped, will provide a substantial contribution to Iranian oil supplies.

Air Transport in New Guinea Goldfields.—The rapid development during recent years of the Bulolo goldfield is attributed in no small measure to the use of aeroplanes for transport of machinery and other equipment over the 35 miles of mountainous and tropical country from the Port of Lae to the actual dredging properties which are situated about 2,250 ft. above sea-level. From April 1931 to December 1936 the three aeroplanes owned by Bulolo Gold Dredging, Ltd., and operated by Guinea Airways, Ltd., carried a total load of 17,255 short tons without accident to personnel or loss of machinery and with only one mishap to an aeroplane.

The cost of this transport is discussed in detail by C. A. Banks in a paper recently submitted to the Institution of Mining and Metallurgy, and published, subject to revision, in the *Bulletin* of the Institution for September 1937, pp. 3-9. According to this authority, an average of 266 short tons of material was carried per calendar month from May 31, 1932, to November 30, 1936, at a cost of $49·935 per short ton, made up as follows :

	$	Percentage cost.
Loading and unloading	1·1176	2·24
Operating costs	17·8911	35·83
Maintenance and repairs of aeroplanes	7·8225	15·67
Maintenance of aerodromes and buildings	1·4231	2·85
Management	12·4525	24·93
Insurance	7·5369	15·09
Major aeroplane repairs in excess of those covered by insurance	1.6913	3·39
Total cost per ton of 2,000 lb.	$49·9350	100·00
Equivalent cost in British currency (at $5=£1)	£9 19*s*. 9*d*.	

If amortisation on aeroplanes, buildings, equipment, etc., be assumed at 8 per cent. per annum, and 12 per cent. be allowed for engine spare parts, the total cost for transport will be increased to $61·78 per short ton, or approximately £12 7s. 0d.

At present four dredges are in operation in the Bulolo district, each with a bucket capacity of 10½ cu. ft. Another dredge, specially sectionalised for air transport, is now being erected, the heaviest parts being as under:

Upper tumbler shaft	7,550 lb.
Lower end castings of digging ladder . .	6,600 lb. each
Ladder winch drum	6,500 lb.
Lower tumbler body—two halves at . .	6,500 lb. each
Bucket idler rim and spokes—two halves at .	5,500 lb. each
Upper tumbler body—two halves at . .	5,000 lb. each

For the two years ended May 31, 1936, the average total cost (including royalty and amortisation), of producing 1 oz. of gold was $10·702 (£2 3s. 0d.).

Radium Recovery in Canada.—The process used in the recovery of radium from the pitchblende obtained at Great Bear Lake, Canada, has been recently described by M. Pochon (*Chem. Metall. Engng.*, 1937, **44**, 362).

The ore is given a preliminary mechanical concentration at the mine and hand-picked lumps and concentrates are sent to Port Hope, Ontario, where the chemical operations are carried out. The concentrate, which contains from 35 to 50 per cent. of uranium oxide and from 1 to 7 per cent. of silver, is roasted to decompose the sulphide and carbonate minerals and to volatilise some arsenic and antimony. The residue is then roasted with salt to convert silver and uranium into chlorides, and the ground product is leached with 50 per cent. sulphuric acid for six hours. Barium chloride is added to collect the radium, hydrochloric acid to precipitate any silver remaining in solution, and sodium nitrate to oxidise uranium. The acid solution, which contains uranium with other soluble metallic impurities, is filtered off and treated with an excess of sodium carbonate, which precipitates iron, manganese, and most of the copper, the solution which is separated containing sodium uranyl carbonate. An excess of sulphuric acid is added to this and uranium finally separated as insoluble sodium uranate by addition of caustic soda. The crude product is further purified and commercial grades of yellow or orange sodium uranate, uranium oxide, nitrate or acetate, prepared from it.

The insoluble residue from the original sulphuric acid leach, containing radium, barium, silver, lead, and other impurities, is then agitated for three hours in a steel drum with

sufficient sodium thiosulphate solution to dissolve out the silver. After filtration and washing, silver is precipitated from the filtrate by means of sodium sulphide, the silver sulphide being filtered off, dried, ground, and shipped to silver refineries in the United States. The residue from the thiosulphate leach contains from 12 to 18 per cent. of lead, most of which is removed by boiling with caustic soda solution in a steel kettle for 1½ hours, filtering and washing. The insoluble portion is boiled with a solution of soda ash in an autoclave for six hours, whereby radium and barium sulphates are converted into carbonates, which are filtered off and dissolved by boiling with strong hydrochloric acid. Silica, containing a trace of radium, which it is not practicable to remove, remains insoluble and is filtered off.

The acid solution is then agitated with a slight excess of sulphuric acid for six hours, after which the impure radium and barium sulphates are allowed to settle. The product after filtration constitutes about 1·5 per cent. by weight of the original ore treated. The crude sulphates are treated on a smaller scale in the laboratory, where they are first converted to carbonates by boiling a suspension with soda-ash, and after filtration and washing are dissolved in hydrobromic acid. The liquor is then treated with barium hydroxide and sulphide to separate the last traces of metallic impurities, the precipitate obtained being again worked up for radium before rejection. The resultant bromide solution contains about one part of radium to 400,000 parts of barium.

The final separation of radium from the bulk of the barium is accomplished by a complicated system of fractional crystallisation. The bromide solution is evaporated until crystals separate which are relatively richer in radium than the mother liquor, which is decanted off. A series of quartz evaporating basins and Monel metal pails for the reception of the mother liquors is arranged to facilitate the production of crystals successively richer in radium, until, finally, after ten crystallisations the head fraction contains one part of radium to about 600 of barium. These head fractions are stored until sufficient are accumulated to carry out the same process using them as a starting material. In this way a final concentrate containing 9 parts of radium to 1 of barium is obtained, which is dried and sealed up in glass tubes for distribution. Over 95 per cent. of the original silver content of the ore and over 90 per cent. of the radium are recovered.

Canadian Bentonite.—Although little, if any, bentonite has hitherto been worked on a commercial scale in Canada, the material is widely distributed in Saskatchewan, and deposits of considerable economic interest have been located during

recent years within easy reach of existing railways. Preliminary investigations have revealed good outcrops of the clay along the valleys of the Frenchman river and its tributaries in the Cypress hills (especially near Eastend, Knollys, and Ravenscrag), to Neidpath and the United States border south of Val Marie. Deposits have also been discovered in the vicinity of Twelve Mile Lake approximately 100 miles east of the Cypress Hills, and at St. Victor, Willowbunch, Harptree, and other places. Of the occurrences so far examined, however, those near Knollys and Twelve Mile Lake appear to be most promising, the reserves in the neighbourhood of the former locality being estimated at a minimum of 2 million tons of dry bentonite.

According to a report by W. G. Worcester, Professor of Ceramic Engineering in the University of Saskatchewan (*Canad. Min. Metall. Bull.*, 1937, **304**, 438-451), raw bentonite from the Knollys district has a marked decolorising effect on peanut oil, and, when activated, offers much promise as a bleaching agent for mineral oils. Samples from near the lower end of Twelve Mile Lake were shown to have high bonding powers, and to be highly colloidal, thus enabling them to remain in suspension almost indefinitely. They are stated to be well suited for many purposes where bleaching is not required, as in paint, paper, moulding sands, etc. Most of the Canadian bentonites, however, do not remain in suspension for long periods, unless treated with a dispersing agent.

More than 100 samples of bentonite, chiefly from the Cypress Hills and St. Victor district, have been examined by Professor Worcester, and, in numerous instances, laboratory experiments have been carried out in order to ascertain their compressive and tensile strengths, bleaching efficiency, permeability, and loss on activation, as compared with other clays. He concludes that there are large quantities of commercial bentonites available in Saskatchewan and that the most successful producers will, in the future, be those who establish their treatment plant at a favourable point, so that they can draw their raw material from several deposits and consequently be in a position not only to guarantee a constant, uniform supply, but also to make blends having different physical and chemical properties to meet the necessarily wide market requirements. In the refining and final treatment processes, accurate plant control should be provided, so that irregularities in the finished product may not occur.

The deposits so far investigated by the author occur in Upper Cretaceous and early Tertiary rocks, and are believed to have resulted from the decomposition of volcanic ash. They are remarkable for their variable degree of expansion when wetted with water, some of the clays increasing to as much as twenty times their original volume. As a result of this peculiar

property, instances are known in Western Canada where railway tracts have been heaved up and pushed out of line through the swelling of the underlying bentonitic beds.

Beryl in the Ceramic Industry.—The increasing demand during the last few years for beryl, not only as a source of metallic beryllium and its oxide, but for use as a raw material of the ceramic industry, has led to the utilisation of material which was formerly discarded as not being of gem quality.

Foote Prints (1937, **10**, No. 1, p. 1) contains an interesting article by D. W. Luks describing the part played in ceramics by this substance.

Beryl is found in commercial quantities principally in India, South America, Scandinavia, South Africa, Canada, and the United States, and is usually obtained from mines operated primarily for such minerals as felspar and mica. The crystals are generally well formed, and are never found in solid veins, but are scattered throughout pegmatite or a similar matrix.

Beryl of satisfactory quality for ceramic work should contain not less than 10 per cent. of beryllium oxide, the percentage in commercial material usually ranging from 10·5 to 11·5. One or more of the oxides of potassium, sodium, lithium, cæsium, calcium, iron, and chromium is nearly always present, chemically replacing the beryllium oxide in amounts varying from 0·25 to 5 per cent. The total content of alkalis, ranging from 0·5 to 2·5 per cent., is only of importance when the beryl is intended for special purposes such as the manufacture of electrical porcelain.

The author claims that by the substitution of beryl for part of the felspar in porcelain mixes, products are obtained which have increased strength, increased electrical resistance at high temperatures, greater resistance to impact and heat-shock, and lower thermal expansion. The replacement of felspar by beryl, however, causes the development of large amounts of cristobalite and mullite in the body, in quantities not necessarily governed by the percentage of silica in the mix, but in some way proportional to the amount of beryllium oxide present. It follows, therefore, that there is need for careful control of the amount of beryl introduced, and also of the amounts of other fluxes such as felspar which may dissolve the cristobalite or restrain its formation.

The effect of the addition of beryl to glazes is, in most cases, very marked. Generally speaking, beryllium glazes seem to be highly fluid and of rather short firing range. Careful temperature control of the glost oven is necessary, otherwise excessive crystallisation is apt to develop. This tendency to crystallisation can, however, be turned to advantage when compounding matt glazes designed for talc-base bodies of

low expansion. One of the most striking properties of beryl is its ability to aid in the development of high temperature chrome green glazes. These colours can be produced with a certainty never previously obtained, by substituting beryllium oxide for potassium oxide in the glaze.

Use of Barium Carbonate in Sulphate-resistant Concrete.—One of the most destructive agents with which concrete can come into contact in normal use is water containing sulphates in solution. In order to render concrete resistant to such waters, H. Jordt ("Bariumkarbonat ein Betonschutzmittel gegen sulfathaltige Wasser," *Tonind.-Ztg*, 1936, **60**, 443-4) has proposed the addition of 0·5 to 1 per cent. of finely ground witherite (barium carbonate). This compound is claimed to prevent the formation of calcium sulpho-aluminate, a reaction which usually takes place in concrete exposed to sulphate-containing waters, by combining with the sulphate to form insoluble barium sulphate. Small-scale trials have shown that concrete with such an admixture is highly resistant to water containing calcium sulphate in solution.

Sodium Sulphate in the United States.—A report has recently been published dealing with crude and refined sodium sulphate, with special reference to the production, consumption, and foreign trade of the United States (*U.S. Tariff Commission, Rept. No.* 124, Second Series, 1937). In the last ten years exports of sodium sulphate from the United States have declined, whereas imports, which were originally of little significance, now far exceed exports and account for over 38 per cent. of the apparent total consumption. The factors which have brought about this change are reviewed in this report.

More than four-fifths of the total United States production of salt-cake is obtained as a co-product in the manufacture of other chemicals, chiefly hydrochloric acid, at works situated in the North Atlantic and North Central States. The rest is obtained from deposits of natural sodium sulphate in the Western States. The sulphate pulp industry, which has expanded considerably in the last few years and which now accounts for over two-thirds of the total consumption of salt-cake in the United States, is carried on in the Gulf and Pacific Coast States, in which very little salt-cake is produced. Salt-cake manufactured in the Northern States has to stand a very high freight charge to reach the southern markets, and much of the salt-cake used in the sulphate pulp industry is, therefore, imported from Germany, where the cost of production is less, shipping charges being relatively low.

The situation is complicated by the fact that hydrochloric acid is now being obtained by other processes which do not

involve the production of salt-cake, for example, the manufacture of chlorinated organic products and the direct production of hydrochloric acid by the combination of chlorine with hydrogen or natural gas. Thus, although the total annual production of hydrochloric acid in the United States has increased in recent years, the output of chemical salt-cake has diminished considerably.

It has been proposed to manufacture salt-cake in the Southern States where the raw materials, salt and sulphur, are at hand, and where there is a ready market; but for profitable operation the co-product hydrochloric acid must also be sold locally, as it is expensive to transport. There is, however, little demand for hydrochloric acid in the Southern States, but the suggestion of converting it to chlorine, which could be used locally for bleaching textiles and sulphate pulp, is being considered. Failing this, other methods of producing salt-cake might be developed, which do not involve the production of hydrochloric acid, or in which this product is utilised. For instance, in the viscose process of manufacturing rayon, the waste liquors contain considerable quantities of sodium sulphate, which, however, cannot be economically recovered at the present market price for salt-cake.

A process of obtaining potash from polyhalite has been worked out by the U.S. Bureau of Mines, and one of the by-products is magnesium sulphate, which when treated with common salt yields sodium sulphate. As the deposits of polyhalite are unfavourably situated with regard to the salt-cake market, the question of price is again important. If it were possible to increase substantially the price obtained for salt-cake in the United States a number of domestic chemical sources of supply would become available.

The same factors limit the production of natural sodium sulphate, for although the United States possesses considerable deposits, these are for the most part unfavourably situated with respect to a market.

RECENT RESEARCH ON EMPIRE PRODUCTS

A Record of Work conducted by Government Technical Departments Overseas

AGRICULTURE

Soils

Malaya.—According to the report of Mr. J. H. Dennett, Senior Chemist (Soils) for the half-year January to June 1937, investigation was commenced on the differences which exist

between various clays in Malaya as shown by differing responses of plant growth. The clays under examination show no essential difference in the ordinary methods of chemical or mechanical analysis. The most promising lines of approach have been investigation of the calcium content of variously prepared clay fractions and the losses on heating to graduated increases in temperatures between 200° C. and 700° C.

Palestine.—The following note on the research work which has been completed during the six months ending June 30, 1937, in the agricultural branch of the Government Central Laboratories, has been furnished.

Analysis with subsequent experimental work has been carried out in connection with the pan (Nazas) formation on the local red sandy soils of the citrus belt. The results obtained confirm the idea held that the Nazas is a degradation product caused by the removal of the binding link between clay and sand. This link or relation is due to the presence of calcium in soils. But this link is being constantly disturbed by the removal of calcium by living trees, as well as by rainfall and excessive irrigation, thus causing a separation of the aluminium and iron from the soil complex and the appearance of the dark nodules of iron-oxide, which is the first sign of the Nazas formation. Such degradation could be overcome by the avoidance of excessive irrigation and the addition of humus-forming manures and lime as protective measures for the maintenance of such equilibrium in the soil. A paper dealing with this subject has been written by M. Puffeles and has been accepted for publication in *Soil Science*.

Experiments carried out on some arid soils (heavy, light and calcareous soils) have shown that, similarly to humid soils, a neutral salt (KCl) extract has a lower *p*H value than the corresponding water-extract. This is of significance in farming in connection with the use of suitable saline fertilisers and the means necessary to protect the soil from excessive change of *p*H. A paper on this problem was written by M. Puffeles and has been submitted for publication.

Manures

Malaya.—Mr. J. H. Dennett, Senior Chemist (Soils), in his half-yearly report for January to June 1937, mentions that the large-scale experiments on composting pineapple waste started last year were continued. With a waste of such high moisture content rain was found to retard considerably the normal course of decomposition. Fruit waste was found to compost more readily than mixtures of fruit and leaves.

Uganda.—The following account of experiments on manures

conducted at the Serere Plantation, is contained in the report on the Plantation for the half-year January to June 1937.

Manurial Experiment.—The object of this experiment, which was commenced in 1933, is to compare varying amounts of farmyard manure and lime applied prior to a green manure crop as a measure for increasing the yields of commercial crops and as a possible measure of keeping up fertility.

The rotation used is:

1st year . .	Green manure.
	Cotton.
2nd year . .	Millet (*Eleusine coracana*).
	Cotton.
3rd year . .	Groundnuts.

The manure is applied at the rate of 10 tons, 20 tons and 30 tons per acre and the lime at the rate of 2 tons per acre before the green manure.

The experiment commenced its second cycle in 1936 and the results obtained from the cotton crop were in favour of manuring. There was no significant difference between the three applications of manure but they all gave significantly greater yields than either the limed or the control plots. The results obtained from the same crop in the first cycle were not significant, while the combined results from the whole of the first cycle, worked out on the cash value of crops, showed no difference between the manured plots and the control, though the former gave a significantly higher return than the limed plots. Thus the trend of this experiment would seem to indicate that while the land was in good heart the application of manure was valueless, but as the soil is losing structure and becoming impoverished manuring is becoming more beneficial.

Compost.—The manufacture of compost was continued during the early part of the period under review, the Indore system being modified in a few small details in order to simplify it as much as possible and at the same time lower the cost of manufacture. With this in view compost was made of a single material, namely *Imperata cylindrica.* This grass, which is present in abundance in most parts of the Eastern Province of Uganda, is useless for grazing and provides ample bedding throughout the whole year. It is therefore the material most readily available in the short grass areas should the native ever take up composting. This material was not chaffed or crushed in any way before being used for bedding, any breaking up process being omitted in order to keep the cost as low as possible; instead, the heaps of compost were given two extra turns and allowed a longer period to complete the rotting process. All operations, such as watering and

turning, for the sake of simplicity, were done at weekly and fortnightly intervals.

As might be expected from a tough grass of low nitrogen content, the whole process was slower than when a mixture of materials, such as advocated in the Indore system, is used, and the resultant compost was lower in nitrogen content, but in spite of this it proved to be excellent as a top dressing.

INSECT PESTS

Locusts

Nigeria.—Mr. F. D. Golding, Senior Entomologist, in his report on the work of the Entomological Section of the Agricultural Department for the half-year January to June 1937, states that during last January and February the annual patrol of the southern shore of Lake Chad was carried out. The inundations of 1936-37 were the most extensive there have been for at least 30 years and the area of grassland suitable for red locusts was considerably reduced. Red locusts were found only at Kalkala and were not numerous in that locality; all the specimens collected were in the solitary stage.

Only two African migratory locusts were seen during the patrol.

Tsetse Fly

Nigeria.—In the report above mentioned, Mr. F. D. Golding states that during late April and early May, fly surveys were carried out in 17 localities in the Ilorin Province and also at Moor Plantation, Ibadan, in connection with the Middle Belt Cattle Scheme. *Glossina palpalis* R.D., was the only species found in the proposed unit farm areas and the flies were confined almost entirely to the shady parts of watercourses. One specimen of *Glossina submorsitans* Newst. was taken on the trade cattle route north of Bode Sadu, and one specimen of *G. tachinoides* Westw. was collected on the same route near Ilorin.

INSECTICIDES

Derris

Malaya.—Mr. C. D. V. Georgi, Senior Chemist, in his half-yearly report for January to June 1937, gives the following account of research work on Derris.

The results of analysis of further samples of roots from individual plants of *Derris elliptica* (Singapore type) based on the classification suggested by Mr. M. R. Henderson, Curator, Botanic Gardens, Singapore (see *Malayan Agric. J.*, March 1934), indicated that Changi No. 3 was still the best in

respect of both rotenone and ether extract. The investigation has now been completed. A summary of the results is given below. The plants were all between 23 and 24 months old when lifted and the figures for rotenone and ether extract are calculated on a moisture-free basis.

Type of Root.	Average Rotenone.	Average Ether Extract.
	Per cent.	*Per cent.*
Changi No. 1	5·9	21·9
Changi No. 2	6·6	22·0
Changi No. 3	9·2	26·4
Singapore No. 1 . . .	5·3	15·8
Singapore No. 2 . . .	6·1	15·9

A similar investigation to the above is being carried out with *Derris malaccensis* with the object of isolating both mixed populations and individual plants of superior toxic content. The following varieties will be included:

(*a*) *D. malaccensis* var. *sarawakensis*
(*b*) Do. tuba merah
(*c*) Do. Kinta type.

The last variety would appear to be similar to that referred to in technical literature as Sumatra type root.

A further experiment has been commenced at Serdang in connection with the variations in yield of root and toxic content with increase in age of plants. The variety under trial is *D. malaccensis* var. *sarawakensis*. The first harvesting was carried out when the plants were 15 months old. The figures for toxic content were somewhat surprising. As far as marketable roots (that is roots of a diameter of ½ in. or less) are concerned the figures for ether extract, calculated on a moisture-free basis, varied from 29·05 to 18·67 per cent. for the different plots. The average figure was 24·95 per cent.

Bearing in mind the variations which are known to exist between individual plants, the results indicate that the view formerly held (see *Malayan Agric. J.*, September and October 1929) regarding the increase in toxic content with age of plant and the attainment of a maximum at or about 24 months is incorrect. It seems more than likely that toxic content develops at a much earlier age. Further work is proceeding.

An experiment has been carried out to obtain an indication of the extent to which toxic content is influenced by change of environment. A mixed supply of cuttings of *D. malaccensis* var. *sarawakensis* was divided into two lots. One lot was planted at the Experimental Plantation, Kuala Lumpur, the other at Serdang. In the latter case the cuttings were planted on land of known high fertility. In both cases the plants

were harvested at or about 24 months. The figures were as follows :—

	Serdang.	Kuala Lumpur.
Average yield of marketable air-dry root per plant . . . *oz.*	8·15	4·20
Ether extract (moisture-free basis) *per cent.*	24·21	24·77

The results indicate, therefore, that with the mixed population, environment does not influence toxic content to any appreciable extent. There is, however, a striking increase in yield of root as a result of richer soil conditions.

The tentative method for the estimation of rotenone adopted in this Department (see *Malayan Agric. J.*, October 1936) has been studied mainly with the idea of shortening the period of the original extraction. Comparative experiments showed that the period of treatment with carbon tetrachloride could be reduced to 12 hours provided the powdered root was dried and ground in a mortar at the end of the first six hours extraction.

Mr. N. C. E. Miller, Acting Senior Entomologist, reports that biological tests with aqueous solutions of three types of derris are in progress, the subjects used in them being the following insects: *Epilachna indica* Muls. (Coleoptera—Coccinellidæ), adults and larvæ; *Chætodacus cucurbitæ* Coq. (Diptera—Typetidæ), adults; *Spodoptera pecten* Guen. (Lepidoptera—Noctuidæ), larvæ; *Apogonia cribricollis* Burm. (Coleoptera—Melolonthinæ), adults; *Dysdercus cingulatus* F. (Rhynchota—Pyrrochoridæ), adults, and in tests with rotenone, deguelin, and toxicarol, *Periplaneta americana* L. (Orthoptera—Blattidæ). *Valanga nigricornis* Burm. (Orthoptera—Acrididæ) is also occasionally used. It would be premature to express an opinion as to the data that these experiments will yield, but the indications are that they may produce results showing the types of insects likely to be susceptible to *Derris*.

Haiari

Malaya.—Mr. C. D. V. Georgi, in the report mentioned above, states that the plants introduced into this country from British Guiana through the agency of the Royal Botanic Gardens, Kew, as black and white haiari have now been identified as follows :

Black haiari . *Lonchocarpus chrysophyllus* Kleinh.
White haiari . *Lonchocarpus Martynii* A. C. Smith.

The results of analysis of both species showed them to be poor both in rotenone and ether extract compared with high grade derris, for example, Changi No. 3. The following table gives comparative figures, calculated on a moisture-free basis, for marketable roots from two-year-old plants of both species ;

figures for *D. elliptica*, Changi No. 3, are added for purposes of comparison.

	Rotenone. *Per cent.*	Ether Extract. *Per cent.*
D. elliptica, Changi No. 3 .	9·2	26·4
L. chrysophyllus . . .	3·0	7·9
L. Martynii . . .	0·8	8·1

A detailed report on Mr. Georgi's investigation is published in the *Malayan Agric. J.*, August 1937.

BEVERAGES

Cacao

Gold Coast.—According to the report of the Department of Agriculture for the period January to June 1937, further investigation into the cause of the curious malformations of the young chupons in cacao, which are associated in many cases with the death of trees, has revealed that a *Colletotrichum* fungus can no longer be regarded as the causative agent. An intensive search throughout farms in the district from which this phenomenon was first reported has revealed that it is much more widespread than was first imagined, and it has been located in varying degrees of intensity over an area of some 100,000 acres. An officer of the Imperial Mycological Institute visited the Colony, and the Plant Pathologist of Sierra Leone has also been seconded to study the problem. They have been unable to find any parasitic organism in association with the swellings on the chupons, the cause of which is still not clear, but is regarded as physiological. The death of trees is now regarded as mainly, if not entirely, due to drought die-back as a result of unsuitable environmental conditions, undue exposure of the trees having taken place through lack of surrounding vegetation to maintain humidity, and to give shade and protection from drying winds. Active steps are being taken to encourage remedial plantings in the area on a large scale.

Coffee

Uganda.—The following results of experiments with Robusta coffee carried out at the Bukalasa Experiment Station are recorded in the half-yearly report on the station for January to June 1937.

(1) *Shade and Cover Crop Experiment.*—The yield for the 1936-7 season were as follows:

Yields in lb. of fresh cherry per acre

	No shade.	Banana shade.	Glyricidia shade.	Mean.
Clean weeded .	6,395	5,388	5,204	5,661·3
Permanent cover .	6,295	5,052	5,138	5,495·7
Mean . . .	6,345	5,220	5,171	5,578·7

The results are significant when P=0·01 and the least significant difference is 658, thus there was no difference in yield between clean weeding and permanent cover irrespective of shade or no shade; while no shade gave a better yield than either banana or glyricidia shade. Both no shade treatments yielded better than the other treatments.

The crop is the second largest harvested, the annual totals of wet cherry in the last five years being as follows:

Year.	Total yield. *lb.*	Yield per acre. *lb.*
1932-33	19,620	3,820
1933-34	41,139	8,000
1934-35	23,031	4,500
1935-36	28,483	5,550
1936-37	33,472	6,500
Total	145,745	28,370

This is equivalent to 12½ tons of fresh cherry per acre in five seasons.

(2) *Ground Treatment Experiment.*—The mulched plots remained outstanding in appearance throughout the season. It was particularly noticeable that in dry weather the amount of leaf shedding was very much less in the mulched plots than in the clean weeded and weed cover plots.

The yields to date are as follows:

Treatments.	Yields of fresh cherry per acre.	
	1936/37 season. *lb.*	Grand Total to date. *lb.*
ın weeding	9,177·0	25,168·6
ched	12,874·5	29,095·0
er crop	9,027·5	14,568·2
ɜd cover	7,698·1	10,931·9
st significant difference	2,861	—

The increase over the other three treatments due to mulching is significant, while there are no differences between the other three treatments.

(3) *Shade and Ground Treatment.*—The first crop was harvested from the experiment during the season, but the only treatments which have been applied so far are shade and cotton seed.

Mulching commenced early in 1937, and it was arranged for the first cover crop to be planted in October 1937.

The effect of the annual applications of cotton seed to half

of each plot is pronounced and the yields were considerably more than those of the untreated plots.

The total yields to date are as follows :

Treatment.	Yield of fresh cherry. lb.
Cotton seed	4,000
Control	2,363
Shade	2,919
No shade	3,449

CEREALS

Maize

Nigeria.—In his report on the work of the Entomological Section of the Agricultural Department for the half-year January to June 1937, Mr. F. D. Golding, Senior Entomologist, states that from February 9 to June 16 experiments were carried out with the object of finding a simple method of protecting shelled maize (intended for seed) from the depredations of the weevil (*Calandra oryzæ* L.) during the storage period. Very promising results were obtained by mixing the maize with paradichlorbenzene or flaked naphthalene at the rate of 2 gms. of the former chemical or 5 gms. of the latter to 50 oz. of shelled maize and then covering the grain with a 3 in. layer of dry river sand. After four months in a heavily infested store only from 1 to 2 per cent. of the grains were damaged as compared with from 41 to 42 per cent. when sand only was used. The layer of sand prevented the vapour given off by the chemicals from dispersing. The cost of the treatment would be from 3d. to 3½d. per cwt. of maize. It is proposed to test the method on a large scale. The viability of the seed was not adversely affected.

Rice

Malaya.—Mr. N. C. E. Miller, Acting Senior Entomologist, in his half-yearly report for January to June 1937, states that investigations into the population fluctuations of the rice borers have been continued and the previous findings are supported by recent results except for one discrepancy. Yields of rice on the whole have been lower during the past year, but exhibit a similar fluctuation trend to those of the previous three years of the experiment, while the number of borers, assessed by counts of egg-masses, has been generally greater than previously.

The investigation is now being extended to include the egg-parasites of borers in order to ascertain whether these have a similar population change to the borers themselves.

Root Crops

Sweet Potatoes

Uganda.—The results of an experiment with sweet potatoes, comparing the ridge and the hill methods of planting and employing the " Kawa " and " Kaungezi " varieties, are given in the report of the Bukalasa Experiment Station for the half-year January to June 1937. The following yields were obtained:

	Kawa.	Kaungezi.
	lb. per acre.	*lb. per acre.*
Ridges . . .	6,344	12,022
Hills . . .	5,658	10,704

The yields are low and the figures give Kaungezi a significantly higher yield than Kawa with no difference in yield between ridges and hills. The difference in varietal yields is probably a false one, as under the rotation in use at present it is impossible and impracticable to dig the potatoes in the native fashion, i.e. to remove the tubers with sticks as they ripen. The native criticism of this experiment is that if their method of harvesting were to be adopted the yield of Kawa would be much higher.

Some new local varieties of sweet potatoes were obtained, two of which are reputed to mature three to four weeks earlier than the normal varieties. Both of these, Kyai and Sekolya, are undergoing an extensive trial.

Fruits

Bananas

Malaya.—Mr. N. C. E. Miller, Acting Senior Entomologist, in his report for the half-year January to June 1937, states that a search for predators of the banana borer (*Cosmopolites sordidus* Germ.) suitable for introduction to Jamaica has been in progress for some time. Three possible predators are now under close study, the well-known Histerid, *Plæsius javanus* Er., and two Hydrophilids, *Dactylosternum hydrophiloides* Macl. and *D. abdominale* F.

Citrus

Gold Coast.—The following statement relating to investigations on citrus fruit-piercing moths is contained in the report of the Agricultural Department for the half-year January to June 1937.

Work on loss of crop, incidence of each species, and possible

control of these moths was again carried out at Asuansi and Aburi during the first citrus cropping season, records commencing in mid-April and ending at the end of June when all fruits had been harvested.

At Asuansi two observation plots, each consisting of thirty-two trees were marked off, on one of which (a) all ripe fruits were harvested weekly and fallen fruits collected once weekly and buried, this being considered the most economic sanitary measure that can be undertaken under ordinary plantation management, and on the other (b) harvesting and collection was carried out every two weeks.

At Aburi three plots, (a), (b), and (c), each consisting of sixteen trees of budded grape-fruit, were marked off. On (a) harvesting and collection and burial of fallen fruits were carried out once weekly, on (b) once every two weeks, and on (c) harvesting was done every two weeks, but fallen fruits were collected and buried daily.

At Asuansi, on plot (a), of the potential crop, i.e. total picked plus total fallen, 96·3 per cent. were attacked by moth and therefore useless; *Othreis* spp. were responsible for 89·6 per cent.; 50 per cent. of fruits fell and only 301 sound fruits were picked out of a total of 4,759. On plot (b), of the potential crop 97 per cent. of fruits were attacked by moth, *Othreis* spp. being responsible for 90·4 per cent.; 71 per cent. of fruits fell and only 142 sound fruits were picked out of a total of 1,895.

At Aburi, on plot (a), loss of potential crop amounted to 65·5 per cent., *Othreis* spp. being responsible for 63 per cent., and 81·3 per cent. of fruits fell. On (b) loss amounted to 73 per cent., *Othreis* spp. being responsible for 72·4 per cent., and 88·3 per cent. of fruits fell. On (c) moths accounted for 81 per cent. of the potential crop, *Othreis* spp. being responsible for 79·3 per cent.

As damage was almost entirely caused by *Othreis* spp., which can attack unripe fruits, there was no appreciable difference in loss on all the above plots and so no conclusion can be drawn. Loss might have been less at Aburi as the standard of ripeness taken was later than that taken at Asuansi, resulting in the fruits being left on longer.

In order that a correct impression may be obtained of the loss due to moth attack the following tables give percentage yields of all varieties of budded sweet citrus at Aburi and Asuansi since they came into bearing. The first crop consists of yields from April to June inclusive, and the second September to February inclusive. Normally the second crop is harvested by mid-January, but in 1937 it extended into March.

Aburi

Year.	Percentage Yield 1st Crop.	Percentage Yield 2nd Crop.	Percentage Moth 1st Crop.	Percentage Moth 2nd Crop.	Percentage Moth over year.
1933-4	63	37	84·2	1·3	53·4
1934-5	0	100	—	0·3	0·3
1935-6	2·6	97·4	61	0	1·6
1936-7	41·2	68·8	55·7	0	22·9

Asuansi

Year.	Percentage Yield 1st Crop.	Percentage Yield 2nd Crop.	Percentage Moth 1st Crop.	Percentage Moth 2nd Crop.	Percentage Moth over year.
1934-5	0	100	—	14·6	14·6
1935-6	1·9	98·1	35·9	11·7	12·2
1936-7	73	27	46·7	6·2	35·8

Poison bait experiments were again put in hand at Aburi. Of five solutions tried out the most successful appear to be those in which sugar cane syrup or Demerara sugar forms the attractant with the addition of sodium arsenite. Baits containing Demerara sugar have been found the most effective in Sierra Leone, whereas in the past sugar cane syrup baits have been found the most effective in the Gold Coast. A disadvantage of the latter is that solutions have to be changed weekly on account of fermentation which makes them unattractive.

Leeward Islands. *Dominica.*—The report by Mr. F. G. Harcourt, Agricultural Superintendent, Dominica, for the period January-June 1937, contains the following notes on investigation work carried out on citrus fruits.

Lime Breeding Work.—The seedlings raised from the further back-crossing of back-crosses of the F.1 generation have now been budded on sour orange stock and are making satisfactory growth. They will be ready for transplanting shortly.

Stock Trials for Limes.—The triplicate series of limes budded on sour orange, rough lemon, and grapefruit stocks continued to do well, and those on grapefruit stock continue to give higher yields. The yield on all stocks were somewhat less than for the corresponding period last year owing to unfavourable weather conditions.

Grapefruit and Orange, Variety and Stock Trials.—The trees on the whole continue to make satisfactory growth, and the earlier plantings, varying from 4 to 5 years old, bore a small crop.

Government Fruit Farm.—The citrus trees are now making

more satisfactory growth. Even the most backward trees have developed considerably with the result that the plots now present a more uniform appearance than hitherto, although there is still a marked variation in the size and stage of development of the trees in many sections. A fair number of the older grapefruit and orange trees are carrying small crops. The application of phosphate and lime to the citrus trees was continued, while much attention was given to drainage and the further establishment of windbreaks. A small supply of Coccinellid beetles was received from the Imperial College of Tropical Agriculture, Trinidad, and liberated on the farm. These beetles are predaceous on scale insects in Trinidad, and an effort is being made to introduce them into Dominica.

Plant Distribution.—Plants in the nurseries are clean and healthy, and the demand for budded citrus is keen, but it is feared that the supply of plants will fall short of the increased demands. The chief items distributed during the first half of the year 1937 were: Washington Navel Orange, 564; Budded Oranges "Other," 143; Grapefruit, 7; Portugal Orange, 1; Budded West Indian Lime, 45.

Demonstration Plots, Experiment Station.—In view of the indications given by plots 1, 2, and 3 that the lime budded on grapefruit gives a heavier yield than on other root-stocks and also produces trees of dwarfer growth and more spreading habit, which is a definite advantage for the picking of green limes, a certain number of grapefruit trees were top-worked with limes. The longevity of the lime on the grapefruit stock, however, being uncertain owing to the susceptibility of this stock to gummosis, it is hoped to ascertain whether the desirable characteristics aforementioned can be combined with those of a root-stock having greater powers of resistance to hurricanes and disease. With this object in view, nursery plants of fully seeded varieties of grapefruit budded on sour orange stock were top-worked with limes and fifty-five of these trees were planted in plot 9c, formerly used for raising citrus plants and later as a banana nursery.

Top-Working of Lime Trees.—Several of the budded lime trees on the sour orange stock which were successfully top-worked with grapefruit have borne a few fruits, and those on rough lemon and grapefruit stocks which were later similarly treated have made satisfactory growth. Plot 8b contains 16 trees, 8 on rough lemon and 8 on grapefruit stock, and plot 9a, 34 trees on sour orange stock. All failures have been removed and the pickets replanted with well-grown nursery plants of Marsh grapefruit on the appropriate root-stock. So far there does not appear to be any marked form of incompatibility between the lime and the grapefruit.

Nigeria.—The report on the work of the Botanical Section, Southern Provinces, for the half-year January to June 1937, contains the following statement relating to citrus investigations.

Stock Trials.—Preliminary yield data are now available for the first citrus stock trials planted at Ibadan. Grapefruit and sweet orange trials were laid down in 1932 with budded trees produced by Mr. J. R. V. Smyth, and the scions used are his selections (see this BULLETIN, 1932, **30**, 336). Trees of the grapefruit trial started to bear in 1935, and the sweet oranges followed a year later. For the purpose of citrus yields the year is taken from April 1 to March 31. Out of a total of 42 trees in the grapefruit trial 24 were in bearing in 1935 and 41 a year later. The tree that has not yet fruited is a supply. The yields of grapefruit trial are summarised in the following table:

Scion—Grapefruit Selection No. 2—Planted 1932

Stock.	Total No. of Trees in Bearing.		Total Yield in No. of Fruits.		Average No. of Fruits per Tree in Bearing.	
	1935-36.	1936-37.	1935-36.	1936-37.	1935-36.	1936-37.
Sour Orange .	2	6	6	1,897	3	316
Sweet Orange .	4	6	43	966	11	161
Acid Lime . .	4	6	67	930	17	155
Rough Lemon .	6	6	67	954	11	159
Shaddock . .	4	6	66	617	16	103
Grapefruit . .	3	6	35	621	12	103
Tangerine . .	1	5	1	457	1	91

Unfortunately the "rough lemon" stock used in these trials has turned out not to be true rough lemon; probably this was derived through several seedling generations from a varietal lemon. It is interesting to note that sour orange stock easily leads in 1936-37.

A census of damaged fruits was made for the above trees, data combined for two seasons:

Scabbed—112 fruits . .	1·66 per cent. of total harvested
Scale—69 fruits . . .	1·02 ,, ,, ,, ,,
Punctured—113 fruits .	1·67 ,, ,, ,, ,,
Blemished—88 fruits . .	1·30 ,, ,, ,, ,,

These counts were made separately for each cause of damage. No count was made of the total number damaged from whatever cause, but such a record will be commenced in future.

In the sweet orange trial 41 trees started to fruit in 1936, and again the one non-fruiting tree was a supply.

Yield 1936-37—*Scion—Sweet Orange No.* 64—*Planted* 1932

Stock.	Total No. of Trees in Bearing.	Total Yield in No. of Fruits.	Average No. of Fruits per Tree in Bearing.
Sour Orange . .	6	3,555	592
Sweet Orange .	6	3,058	510
Acid Lime . .	6	1,559	260
Rough Lemon .	6	664	111
Grapefruit . .	6	1,461	243
Shaddock . .	6	775	129
Tangerine . .	6	1,609	322

In the orange trial, sour orange and sweet orange stocks gave the highest yield, with sour orange slightly leading. Only one damaged orange, a punctured fruit, was harvested during 1936-37.

Seed Content of Marsh Seedless Grapefruit.—Observations were commenced during 1936-37 on the seed content of fruits of the Marsh seedless grapefruit; the results were:

No. of fruits examined	209
Range of seed content per fruit . .	0-12
Average seed content per fruit . .	4·35
Number of trees under observation . .	23
Range of average seed content per tree .	2-7

These observations will be continued in future years.

Mr. F. D. Golding, Senior Entomologist, in his report covering the half-year January to June, states that for the first time on record in Nigeria there was a serious infestation of citrus fruits by fruit-piercing noctuids. Much damage was done to the crop during May; in early June the moths disappeared. A preliminary test of a bait of the Gunn type gave promising results; the mixture used was ½ oz. of sodium fluosilicate, 8 oz. of treacle, and 6 lb. of water.

Palestine.—The following summaries of experiments conducted by the Horticultural Division of the Department of Agriculture are taken from a Report covering the period January to June 1937.

Trials with Shirlan for preventing Waste in Oranges.—Two small experiments were undertaken in March for the purpose of ascertaining the effect of treating damaged and undamaged fruit with a 1 per cent. solution of Shirlan dipped for one minute; in the case of the damaged fruit some samples were dusted with mould spores and others left undusted. The results, expressed as percentage of wastage, at the end of the twenty-fifth day are shown below. The wastage in the case of some of the injured samples was 100 per cent. in the first week.

	Dipped in Shirlan.		Untreated.	
	1st Test.	2nd Test.	1st Test.	2nd Test.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Fruit undamaged . . .	Nil	Nil	12	17
Fruit with damaged oil cells .	52	17	100	90
Fruit with damaged oil cells and infected with mould spores .	100	86	100	100

Windbreaks.—A study of the effect of cypress windbreaks on the quality and quantity of fruits on orange trees, protected and non-protected, was instituted. It revealed that the protected area showed 4·4 per cent. of dropped fruit, the partially protected 6·4 per cent., and the unprotected 8·5 per cent. The percentages of culls and grades of fruit are shown in the following table :

	Protected Plot.	Semi-protected Plot.	Non-protected Plot.
Total crop . . *number*	20,687	20,992	20,772
Percentage of dropped fruit .	4·4	6·4	8·5
" " culls . . .	13·7	19·7	27·4
" " 1st grade fruit .	47·1	26·9	16·4
" " 2nd grade fruit .	18·4	23·2	17·2
" " 3rd grade fruit .	16·4	23·8	30·5

It will be seen that protection resulted in an appreciable gain in first quality fruit.

Dates

Palestine.—The following preliminary results of a study of the effect of various factors on the rooting of date offshoots are contained in the report of the Horticultural Division, Department of Agriculture, for the period January to June 1937.

(*a*) *Weight of Offshoots.*—Offshoots 5 kilos in weight gave 87·5 per cent. success, those of 10 kilos 76·46 per cent., and of 1 kilo only 29·5 per cent.

(*b*) *Shade.*—Offshoots placed in shaded beds gave no better results than those unshaded.

(*c*) *Disinfecting of Offshoots.*—Dipping and spraying offshoots influence the percentage of success, as the following figures show :

	Per cent. success.
Offshoots dipped in ammonium copper carbonate solution	75
Offshoots dipped and sprayed with ammonium copper carbonate solution	79
Offshoots dipped in Ceresan	50
Offshoots dipped and sprayed with Ceresan . . .	67
Offshoots undipped and non-sprayed	30

(*d*) *Heating of Soil*.—Experiments were carried out in propagation beds heated by electric soil cables. Two beds were not heated and gave 72 per cent. success, one bed was heated to 30° C. and kept constantly at this temperature during the rooting period, and gave 90 per cent. success, and the other was heated to 30° C. for only one month after planting and gave 76·2 per cent. success.

Pineapples

Malaya.—Mr. J. H. Dennett, Senior Chemist (Soils), in his report for the half-year January to June 1937, states that studies on the effect of moisture on pineapple wilt were continued. Examination of mineral matter of wilted and unwilted leaves shows a considerably lower nitrogen content for all wilted samples. This appears to be an effect rather than a cause. Investigations are being made into treatment with ferrous and manganese salts.

Mr. A. Thompson, Senior Pathologist, in his report for the same period, deals with the following diseases of pineapples.

A yellow bacillus, resembling *Erwinia* (*Bacillus*) *ananas*, and species of *Penicillium* have been obtained in culture from fruitlet brown-rot of the Singapore Canning variety more frequently than any other organisms, and are the only ones which reproduce the disease and are again reisolated from inoculated fruits. These organisms also occur in the flowers and appear to be those most commonly associated with the natural decay of the floral parts.

Two diseases of the fruits have been under study. In one, the core of a fruit breaks and a rot associated with bacteria may extend down the core from the crown and laterally in the fruitlets. In the other, the fruit suddenly decays when fully grown but apparently unripe, and the rot may extend down the fruit stalk. This disease has so far only been recorded in the State of Johore.

Fodders

Grasses

Uganda.—According to the half-yearly report on the Serere Plantation for January to June 1937, the grass population of the area surrounding the farm has been mapped out and small plots of the more promising species have been planted for observation on palatability.

For the grass fallows on the Experiment Farm, *Panicum maximum* and *Cynodon plectostachyon*, in pure stands, and a mixture of the two are being used. *Panicum maximum* is one of the grasses most relished by stock, but tends to become

tufted and requires very careful grazing in order to control this tufted habit. Where it has been interplanted with Cynodon there is less necessity for such careful grazing because the Cynodon covers the land between the tufts adequately. *Cynodon plectostachyon* in a pure stand provides an excellent cover, but, at Serere, it is not as palatable as many of the other grasses and is more difficult to eradicate when the land is reopened for cultivation.

Oil Seeds

Ground-nuts

Gold Coast.—The following statement relating to rosette disease of ground-nuts is contained in the half-yearly report of the Department of Agriculture for the period January to June 1937.

The effect of early planting in reducing the incidence of rosette disease in ground-nuts was shown very strikingly in a trial carried out in Tamale in the Northern Territories. Planting was carried out at three different dates, viz., April 23, May 16, and July 3, and six replications of the trial were laid down. The results are clearly shown in the following table:

Planting Date.	Mean Yield.	Cumulative percentage of rosette infection on		
	lb.	July 28.	Sept. 24.	Oct. 16.
April 23 . .	754	0·1	2·3	8·6
May 16 . .	639	0·4	3·4	11·3
July 3 . . .	47	1·3	81·4	not taken

In a further trial to ascertain the effect of clean cultivation as against no treatment after an early weeding to establish the crop, the cultivated plots showed an infection of 28 per cent. rosette as against 2·6 per cent. on the untreated plots. The effect of the cultivation was so beneficial, however, that the final yield of the plots showed an increase of 70 per cent. over the untreated.

Nigeria.—In a report on the work of the Chemical Section, Northern Provinces, for the half-year January to June 1937, Mr. W. A. Watson, Agricultural Chemist, gives the following account of investigations on the oil content of ground-nuts.

Although in previous years the Department's selected strain of ground-nuts had been consistently proved to be superior in oil content to locally-collected seed grown on the departmental farms, doubt still existed as to whether ground-nuts grown on farms were equal to those grown by the farmer on his own land.

It was thought that the native method of pounding the nuts in the decortication process might possibly have a bearing on the matter. Most ground-nuts exposed for sale have been treated in this fashion.

Samples of nuts were obtained from a number of the experimental farms and from native farms closely adjacent. Some were of the improved " Castle Cary " nut and some were local, but each pair of experimental and native farm samples were of the same variety. Portions of each were subjected to decortication by the native method and other portions were hand decorticated.

A consideration of the oil content figures showed that such differences as there were decidedly favoured nuts grown on the departmental farms. The differences between hand shelling and " native " shelling showed a slight superiority for hand-shelled nuts.

Thus no evidence was forthcoming for the contention that the native can grow and market nuts with a higher oil yield than those produced by the Department.

Oil Palm

Malaya.—The following statements relating to research work on the oil palm are contained in the half-yearly report for January to June 1937, furnished by the Adviser on Agriculture.

Mr. C. D. V. Georgi, Senior Chemist, reports that colour determinations of oil from fruits of 392 individual palms of the West African varieties established at the Central Experiment Station, Serdang, have been made.

The results show that many of the varieties yield oils much deeper in colour than that obtained from average Deli type fruit. For example, taking the average colour value of the oil from Deli type fruit when viewed in the form of a 1 per cent. solution in petroleum ether through a $\frac{1}{8}$ in. cell in a Lovibond tintometer as $\begin{array}{ll}\text{Yellow} & 3\cdot0 \text{ units,} \\ \text{Red} & 0\cdot2 \text{ units,}\end{array}$ there were no less than 47 West African varieties in which the colour value on the same basis exceeded $\begin{array}{ll}\text{Yellow} & 9\cdot0 \text{ units,} \\ \text{Red} & 0\cdot5 \text{ units,}\end{array}$ being an increase of approximately 200 per cent.

There are indications that colour of oil is a constant character, the oils from promiscuously pollinated successive bunches of fruit on the same palm varying only very slightly in colour values.

An investigation has been carried out in connection with the mixing of palm oils of varying acidities, such as are exported from Malaya, say from 3 to 5 per cent., calculated as palmitic acid. The results showed that the acidity of a mixed oil could be

calculated from a consideration of the acidities of the component oils and the proportions in which they were mixed. Further, the rate of increase in acidity of the mixed oil on storage was of the same order as that of the component oils, provided the moisture and dirt contents of the latter were of the same order.

Experiments have been carried out in connection with the design of a new form of oil sampling tube suitable for use with barrels, drums, or railway tank wagons. The following is a brief description of the tube. One end of an iron tube of suitable length is faced to fit a conical plug suspended inside the tube by means of a thin iron rod, which is in two parts joined together by means of a short length of steel spring. The upper end of the iron rod is fitted with a short cross-bar which enables the plug, when the spring is in tension, to be drawn up tightly against the lower end of the tube. A slot is provided at the upper end of the tube into which the cross-bar fits when the spring is released. In this position the plug hangs clear of the lower end of the tube. The tube is lowered very slowly into the drum or other container and when the bottom has been reached the plug is moved into position by means of the cross-bar. The filled tube can then be withdrawn. One advantage of this form of sampling tube is that a representative sample of oil can be taken without the necessity of reincorporating the two fractions into which palm oil separates under local conditions.

A new method of drying kernels is also being worked out. The process consists in heating the kernels for between 1½ and 2 hours in a shallow open steam-jacketed pan. The pan is also fitted with a vertical shaft. The steam pressure in the jacket is adjusted so as to maintain a temperature of about 55° C. when the pan is filled with kernels. The latter are kept moving during the process. This is effected by means of scoops fitted to the vertical shaft; the scoops just clear the bottom of the pan and as they revolve the kernels are turned over continuously. Experiments have shown the possibility of reducing the moisture content of kernels from about 11 per cent. to about 7·5 per cent. This reduction is sufficient to allow the kernels to be bagged direct without sweating or becoming mouldy in the sacks. The method has the advantage that commencing with stored nuts kernel manufacture becomes a continuous process, the kernels from the Wilder dry separator being bagged the same day as the nuts are cracked.

Mr. A. Thompson, Senior Pathologist, states that observations on stem-rot disease of the oil palm indicate that the disease is only prevalent on areas of backward palms, especially on valley quartzite soils in which a sand-pan occurs, or in areas of deep peat.

Fibres

Manila Hemp

Malaya.—According to the report of Mr. J. N. Milsum, Acting Senior Agriculturist, for the period January to June 1937, trials with Manila hemp varieties (*Musa textilis*) on coastal alluvial soils demonstrate that very much better growth is made on such land in comparison with inland hill and valley quartzite soils. Owing to the satisfactory appearance of the plants under trial it is proposed to obtain a small stripping machine in order to prepare samples for valuation and report.

Drugs

Cinchona

Malaya.—Mr. C. D. V. Georgi, Senior Chemist, in his half-yearly report for January to June 1937, states that sixty samples of *Cinchona ledgeriana* bark from individual trees growing at Cameron Highlands have been analysed in connection with the selection of high quality budding material for grafting on to *C. succirubra*. Twenty of the trees, which were approximately 9 years old, were growing in the open, the remaining 40, which were between 7 and 8 years old, were growing under light jungle shade.

A summary of the figures for the quinine contents, calculated on a moisture-free basis, is given below:

Quinine. *Per cent.*	Trees in open. 9 years old.	Trees under light shade. 7-8 years old.
10–9	2	7
9–8	11	17
8–7	5	13
7–6	1	3
6–5	1	—
	20	40

FORESTRY

Timber

Cyprus.—The report on research work conducted by the Forest Department during the period January to June 1937, states that a timber preservation test has been started, using ten species of Cyprus timbers, including both conifers and hardwoods. The preservatives used were zinc chloride, red lead, a bituminous solution (locally called Amoa Emulsion), sugar, mercuric chloride, "Shell" preservative, and creosote. It is proposed to establish four "graveyards" at varying altitudes and in different climatic zones, but at present only two have been laid down, at Fresh Water Lake and at

Athalassa plantations. These are situated approximately at sea-level and at 500 ft. altitude respectively and represent maritime and arid climatic conditions.

Resins

Cyprus.—According to a report on research work conducted by the Forest Department during the period January to June 1937, tapping experiments on *Pinus halepensis* have been commenced to ascertain the economical age at which it is best to tap trees in Cyprus, and also whether locality and aspect have much influence on the resin flow. It is hoped that the experiments, which are not yet complete, will provide much useful data for future guidance in case tapping can be established on an economical basis. The tapping experiments are being confined to trees which for silvicultural reasons would be removed within five years. At present it is only proposed to produce turpentine and rosin, but later it is hoped that lamp black and pitch may be produced also. It is not anticipated that resin tapping is likely to become a main forest industry, but rather that Cyprus should become self-supporting in these products.

MINERAL RESOURCES

BRITISH GUIANA

The Imperial Institute has received from the Commissioner of Lands and Mines the following report by the Director on the work carried out by the Geological Survey during the six months ended June 30, 1937.

During the first half of the year the Geological Survey has been engaged upon examinations of the North West, the Cuyuni, and the Puruni Districts.

In the Puruni District the examination of the Kartabo-Quartzstone-Peter's Mine triangle, which includes the Oko and Aremu goldfields, has been completed by the survey of the Mara-Mara Creek and Peter's Mine area. It is hoped to print a complete map of this important area shortly. A number of concessions have been taken up recently in this and adjacent areas and prospecting is being carried out to test certain areas with a view to dredging and quartz mining. Some consideration is being given to proposals for road extensions from Kartabo Point to the producing fields.

In the Cuyuni District an examination has been made of the Aranka River (Pigeon Island) goldfield, which was the scene of a gold rush in 1910. The greater portion of this area is held under Exclusive Permission, and it appears likely that some development will take place.

A reconnaissance survey of the north and western portion

of the North-West District has been carried out and it is proposed to continue this during the next field season. Prospects are very encouraging for the development of quartz mining and for alluvial operations in this district.

The report and maps dealing with the Quartzstone-Waiamu area by Mr. Bishopp have now been printed and issued; at the same time an official notice was published by the Commissioner of Lands and Mines announcing that the Government was prepared to consider the proposals of any mining concerns in regard to the future development of the Government reserved area.

The work carried out by Mr. Bishopp in this area is of primary economic importance. The assays of quartz samples taken from the southern portion of this area on the claims of Mr. Kingston indicate the presence of gold values of 4 dwts., 3 dwts., and 12 dwts. over widths of 10 ft. 5 in., 16 ft., and 18 ft. respectively. These are considered sufficiently favourable to justify further development work with a view to the establishment of mining and milling operations at this locality.

Of equal economic importance is the indication of the possible presence of four million cu. yds. of dredgeable alluvium running 30 to 50 cents per cu. yd. in the Quartzstone River and its tributary, St. George's Creek. Should further testing confirm this it will lead to the early establishment of dredging operations in this area.

As indicated in the previous report, the examination of the Kutuau-Tinamu area by Mr. Bracewell has produced nothing of immediate economic importance. The contact between granite and volcanic rocks of the Quartzstone area appears to pass northwards across this area, but the granitic rock is a gneissose variety and is quite barren. There is some evidence however, that the gold-bearing granite of Quartzstone is connected more directly with the granitic rocks in the vicinity of Tinamu and Paiyuka and the connection between gold mineralisation and the dolerite dykes in this area recorded by Sir John Harrison will be dealt with in the report on this area. The Paiyuka and Tinamu dolerite dykes strike towards the Quartzstone goldfield. They are bordered by gold-bearing hybrid granites, granophyres, and syenites somewhat similar to those noted in the Quartzstone goldfield, and the question to be considered is, which is the more important—the north-south volcanic-granite contact, or the dolerite-granite (granophyre) contacts trending east-north-east.

The report and maps of the Groete Creek-Mariwa goldfields by Dr. D. A. Bryn Davies are almost completed. The map has been compiled on a scale of 1 : 25,000 and reduced to 1 : 125,000. It is hoped to print this and two maps of the important sections of the goldfields shortly. The gold

reserves of the Mariwa River and White Creek, in the river flats and terraces, and in hill deposits like those of Sardine Hill in the Mariwa River, will also be dealt with.

CYPRUS

The Imperial Institute has received from the Inspector of Mines and Labour the following report on mining activities in Cyprus during the first six months of 1937.

Work has been continued without interruption on the larger mines and mineral production is steadily increasing. During the period operations were resumed at the old Limni Mine, and the shipment of trial lots of pyrites from Kalavassos was begun. This mine is expected to become a steady producer in the future.

The asbestos mines at Amiandos were worked to full capacity and the output of fibre is increasing.

Activity in prospecting reached "boom" proportion during the period, the sustaining interest being the search for precious metals, in consequence of which a record number of prospecting permits was applied for and granted. Two new mining leases were also issued during the period.

Mineral Production

	First 6 months 1936.	First 6 months 1937.
Cupreous pyrites (dry weight)	*Tons.*	*Tons.*
Skouriotissa Mine, production	73,544	110,931
„ „ exported	71,604	105,910
Mavrovouni Mine, production	145,671	232,048
„ „ exported	19,802	44,813
Cupreous concentrates (dry weight)		
Mavrovouni ore, exported	26,782	39,264
Cement copper		
Mavrovouni ore	Nil	Nil
Chrome iron ore		
Production	Nil	Nil
Gold (contained in ores, concentrates, and precipitates)	*Troy oz. fine.*	
Skouriotissa Mine		
Mathiati Lease		7,283
Akoliou Lease	8,344	
M. W. Berdy Lease		774
Prospecting Permit Areas		917
Silver (contained in ores, concentrates, and precipitates)		
Skouriotissa Mine		
Mathiati Lease		47,695
Akoliou Lease	51,367	
M. W. Berdy Lease		3,016
Prospecting Permit Areas		6,470

Asbestos (*Tunnel Asbestos Cement Co., Ltd.*)	First 6 months 1936. *Tons.*	First 6 months 1937. *Tons.*
Rock mined	484,859	850,039
,, treated	101,521	130,115
Asbestos fibre produced	3,078	4,144
,, ,, exported	3,276	4,048
Other minerals exported		
Gypsum, calcined	2,057	2,061
,, raw	7,762	5,091
Stone, building, *cu. yds.*	*Nil*	*10*
,, pumice	90	2
Terra umbra	2,289	4,482
,, verte	5	10

GOLD COAST

The Imperial Institute has received the following statement from the Director regarding the work carried out by the Gold Coast Geological Survey during the six months ended June 30, 1937.

Four parties were in the field during the period under review, and their work included the geological mapping and prospecting of the north-western part of the Wenchi District, Ashanti, and a strip of country, 10 to 20 miles wide, stretching north-east from the Anglo-French boundary south-west of Bole to near Navrongo, Northern Territories.

Detailed studies were made of the geology of the Tarkwa goldfield and of the Nsuta manganese-ore deposits, and the workings of most of the active gold mines and prospects were examined.

On April 1 a Water Supply Section of the Geological Survey was formed to carry out the recommendations made by this Department for the improvement of the water supplies in the Northern Territories. The first three months were devoted to the construction of experimental works in Western Dagomba for observation during the rains. Other work consisted in the siting of wells and dams in readiness for the constructional work which is to be started in October.

Manganese.—The results of the detailed investigation of the Nsuta manganese-ore deposits show that the ores lie within a persistent belt of manganiferous phyllites and mudstones interbedded with tuffs, lavas, and minor intrusive igneous rocks of Upper Birrimian age, and indicate that the ores are of sedimentary origin.

Gold.—A quartz reef carrying encouraging gold values at the surface was discovered by the Geological Survey in uninhabited country 11 miles north-north-east of Bulenga, Wa District, Northern Territories.

Publications.—Bulletin No. 8, "The Geology of the Bosumtwi Caldera and Surrounding Country," was published, and Bulletin No. 9, "A Bibliography of Gold Coast Geology, Mining, and Archæology," was in the press.

NIGERIA

The Imperial Institute has received the following statement from the Director regarding the work carried out by the Geological Survey during the six months ended June 30, 1937.

Minerals

Gold.—Field work upon the goldfield has been resumed and the area of investigation extended. There has been a slight decrease in gold production, the amount won for the five months ending May 31 being 10,849 ozs.

Lead-Zinc.—A prospecting shaft at the mine of the Northern Nigerian Lead Mines, Ltd., at Zurak, Adamawa Province, encountered a lode 4 ft. in width near the most promising of the indications afforded by the electrical prospecting carried out last year. This shows that the method of self-potential or spontaneous-polarisation is capable of indicating the presence of Nigerian lead-zinc lodes where they are covered by drift and subsoil. There is little activity at this mine at present.

Stream Concentrates, Borgu Division.—Examination by the Institute of about eighty concentrates collected last year in Borgu Division, Ilorin Province, revealed small amounts of tin in several samples and the presence of columbite-tantalite in a few. It is to be doubted whether economic deposits of either minerals occur in the division.

Harmattan Dust.—A sample of harmattan dust collected at Kaduna was analysed at the Imperial Institute. The most striking feature of the dust was its high content of diatoms. Diatomaceous earth occurs in several areas in north-eastern Nigeria, but usually not on the surface.

Water Supply

Water supply investigations have been carried out in Dikwa Division, British Mandated Territory of the Cameroons administered under Bornu Province. An improved water supply from wells is needed here, and a comprehensive programme has been drawn up. Brief investigations were also made in Bornu and the adjacent part of Potiskum Division

where the geological conditions controlling groundwater distribution are more complex than usual.

The construction of wells has proceeded along the usual lines in the Northern Provinces and this work is now developing in Southern Provinces. During the half-year 93 new wells have been completed.

In Sokoto Province the work now lies in the south-western part of Sokoto Emirate and the adjacent part of Argunga Emirate. Rain has impeded work in the latter area to some extent. The 9 ft. shaft at Katsina intended ultimately to be part of a scheme for a pipe-borne supply to the town has reached water. In Hadejia Emirate a group of wells to the south of the Hadejia River have been completed and a number of the older wells in the northern part of the emirate are being deepened to provide greater yields. Work goes on apace in the Garki and Taura districts of Kano Emirate. In Katagum Division wells are being sunk in Misau Emirate. On completion of these, shafts are to be begun in Gombe Emirate where no well-sinking has previously been carried out by the Department. In Bornu the wells north of Damaturu have been completed and the present programme aims at supplying water to the towns and villages along the main Maiduguri road between Damaturu and Maiduguri. In Potiskum town wells are already being sunk for the school and hospital about to be built.

Work was begun in the Owerri Division of Owerri Province at the beginning of the year. A number of wells have already been completed and the scheme is proving to be a success. The sinking of a group of wells on the Ishan Plateau, Ishan Division, Benin Province, has just been commenced.

Upon the successful completion of the drilled wells at Otta an experimental hole was drilled on behalf of the Public Works Department at Iju in connection with the proposed enlargement of the Lagos Water Supply.

Anglo-French Forestry Commission

A geologist from the Department was attached to the Anglo-French Forestry Commission which was set up to investigate climatic and related problems in the western Sudan geographical region. His special interest was the study of recent geology, physical geography, and groundwater distribution.

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PLANT AND ANIMAL PRODUCTS

AGRICULTURE

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Geologic Factors in the Interpretation of Fluorspar Reserves in the Illinois-Kentucky Field. By L. W. Currier. *Bull. No.* 886-*B*, *U.S. Geol. Surv.* Pp. 5-14, 9×6. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1937.) Price 5 cents.

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Sodium Sulphate: A Survey of the United States Production, Consumption, and Foreign Trade with particular reference to Factors essential to Tariff Consideration. *Rep. No.* 124, *Second Series.* Pp. 57, 9 × 5⅞. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1937.) Price 10 cents.

Sulphur

Sulphur Dioxide Recovery at Trail. By R. Lepsoe and W. S. Kirkpatrick. *Canad. Min. Metall. Bull.*, 1937, No. 304, 399-404. A general picture of the development and installation of the sulphur dioxide plants of the Consolidated Mining and Smelting Company of Canada, Ltd., at Trail, B.C.

NOTICES OF RECENT LITERATURE

Books for review should be addressed to "The Editor," Bulletin of the Imperial Institute, South Kensington, London, S.W.7.

MOISTURE AND FARMING IN SOUTH AFRICA. By W. R. Thompson. Pp. 260, 8½ × 5½. (South Africa: Central News Agency, Ltd.; London: Gordon & Gotch, Ltd., 1936.) Price 21*s*.

That moisture is the dominant factor in the production of crops and animal products in South Africa is unquestionable. A detailed study of all the available evidence on the climatic influences which govern the agricultural development of the Union, such as Mr. Thompson has carried out, is therefore, of inestimable value. Much work will have to be done before all the problems involved are solved, but the author has placed future investigators under an obligation by gathering together such a mass of information and by endeavouring to put the position in its true light. Contrary to the belief of many that South Africa is gradually becoming drier, he claims to show that the present climate has existed without appreciable change during historical times. It is true that there has been a general downward trend in the summer rainfall area since about 1890, but the author contends that "no permanent diminution in the country's rainfall can be claimed, and judging by the character of the rainfall in the past, improved

rainfall conditions (a higher general level) may reasonably be expected in the future."

An enumeration of the chapter headings will indicate the comprehensive scope of Mr. Thompson's enquiry: The alleged drying up of Africa and the amelioration of the drought problem, with special reference to the Schwarz Kalakari scheme; Historic evidence in connection with the alleged drying up of Southern Africa; A study of South African rainfall, secular variations, and agricultural aspects; Rainfall intensity, with special reference to major trends—its bearing on the moisture situation in general; Rainfall, soil erosion, and run-off in South Africa; The rôle of evaporation in the dissipation of moisture; Moisture dissipation through transpiration; The rôle of percolation in the dissipation of moisture; Veld-burning: its history and importance in South Africa.

OVERSEAS PLANT PRODUCTS. By J. H. Holland. Pp. vii + 279, $7\frac{1}{4} \times 4\frac{3}{4}$. (London: John Bale, Sons & Curnow, Ltd., 1937.) Price 6s.

During the time when Mr. Holland was engaged in the Museums Department at Kew, he prepared for his own use a list of trade and common names of plant products which enter the ports of this country or which are used in the place of production, with their botanical source and country of origin. This list forms the basis of the present work. The entries are arranged in alphabetical order, the more important names being distinguished from the rest by being printed in different type. Brief notes are included as to the uses of the products, while for those desiring fuller information in this direction references to the chief literature on different classes of products are given in a Bibliography at the end, whilst references to sources of trade statistics are mentioned in the preface.

The book has been prepared for the use of importers, exporters, and others concerned in handling raw materials, and since no product which they are likely to meet with seems to have been omitted it should serve a most useful purpose.

THE JOURNAL OF THE SOUTH-EASTERN AGRICULTURAL COLLEGE, No. 40, 1937. Edited for the College by S. Graham Brade-Birks, M.Sc., D.Sc., F.Z.S. Pp. 188, $10\frac{1}{2} \times 7\frac{1}{4}$. (Wye, Kent, 1937.) Price 7s., post free; to residents in Kent and Surrey, 4s., post free.

For some time past the *Journal of the South-Eastern Agricultural College* has been published in two parts each year, one devoted to Administrative Reports and the other recording the results of research work conducted by or in association

with members of the staff of the College. The number now under notice falls in the latter category. The papers cover a very wide range and reflect the important part that "Wye" plays in advancing agricultural and horticultural knowledge. Among the subjects dealt with are the control of apple scab, the honey fungus (*Armillaria mellea*), hop varieties, spraying machinery, milk production, soils, pests of mushrooms, millipedes, tests of insecticides against the strawberry blossom weevil, the drying of pyrethrum flowers, the conversion of a pasture into a cricket ground and lawn, brewers' grains as a substitute for millers' offals, hop-drying, and "meta-fuel" for slug control. There is also a very interesting article, with many illustrations, by the Rev. R. W. H. Acworth, on the tokens that were used in the hop gardens of Kent and Sussex.

CHEMISTRY OF FOOD AND NUTRITION. By Henry C. Sherman, Ph.D., Sc.D. Pp. x + 640, $7\frac{3}{4} \times 5\frac{1}{4}$. Fifth Edition, completely rewritten. (New York: The Macmillan Company; London: Macmillan & Co., Ltd., 1937.) Price 12*s*. 6*d*.

The four main factors of nutritive requirement are energy, protein, mineral elements, and vitamins. A work on the chemistry of food and nutrition must embrace a study, not only of these four fundamentals, but also of their interrelationship and of the nutritional reactions or responses of the body as a whole. This is the field covered by Professor Sherman in the fifth edition of *Chemistry of Food and Nutrition*. The more detailed description of individual articles of diet, and the chemical and legal control of the food industry have been treated by the author in another volume.

The large amount of research which has been carried out in recent years on the chemistry of nutrition has necessitated the rewriting of the whole of the subject matter, while the inclusion of entirely new material has added to the size of the work. It is impossible here to give a detailed survey of the text, but special mention may be made of the six chapters devoted to a lucid explanation of the vitamins and also the excellent section devoted to the mineral elements. The reviewer was impressed by the manner in which the whole of the material has been carefully welded together, and also by the list of references given at the end of each chapter. These references are included as an aid to the expansion of the text and are intended to put the reader in touch with significant literature even though they cannot cover it all.

This book has been written primarily to meet the needs of college classes, but it should also be of service to all those who, although appreciating the importance of food and nutrition as factors in health, are unfamiliar with the principles of its scientific foundations.

CACAO FERMENTATION. A CRITICAL SURVEY OF ITS SCIENTIFIC ASPECTS. By Arthur W. Knapp, M.Sc., F.I.C., M.I.Chem.E. Pp. xii + 171, 8¾ × 5¾. (London: John Bale, Sons & Curnow, Ltd., 1937.) Price 10s.

This volume, by the Chief Chemist to Messrs. Cadbury Bros., Ltd., is based on the series of articles entitled "Scientific Aspects of Cacao Fermentation," published in this BULLETIN, 1935, **33**, Nos. 1 to 4, and 1936, **34**, Nos. 2 and 3. Our readers will, therefore, be familiar with the general scope of the work. The author has, however, revised and enlarged the material and has added chapters on temperature and drying. The illustrations have also been added to, and include a coloured plate showing the internal appearance of the dry cacao beans of commerce.

The work should long remain the standard book of reference on its subject, and should be in the hands of all concerned in the production of cacao. As the author says in his preface, one of the best ways of increasing consumption is by attention to the quality of the product. The planter most likely to effect an improvement in quality is the one who bases his practice on scientific principles.

LEGUMINOUS FORAGE PLANTS. By D. H. Robinson, Ph.D., B.Sc., N.D.A. Pp. vii + 119, 8¾ × 5¾. (London: Edward Arnold & Co., 1937.) Price 6*s*.

This book is intended for the use of agricultural students in Great Britain, and its main object is to enable them to recognise the chief leguminous plants grown on the farm. The crops dealt with comprise the various kinds of clovers and medicks (including lucerne); other pasture plants, such as the birdsfoot trefoils and kidney vetch; plants grown as field crops, including sainfoins, lupins, and melilots (sweet clovers); and pulse crops sometimes grown as fodder, such as field beans, vetches, field peas, and soya beans. The general characteristics of leguminous plants are described briefly, including the question of nitrogen fixation, and then follow the detailed descriptions of the plants. The treatment is much the same in all cases: a general description of the mature plant, the characters of the seed and seedling, the history and uses of the crop and its chemical composition are all dealt with, whilst in the case of the more important crops the various cultivated types or strains are described, together with the methods of seed production.

A feature of the book is the illustrations, which are all original and depict not only a shoot of the mature plant, but also the seed and seedling of each plant dealt with. It should prove of great service, not only to students, but to all interested in farm crops.

THE PESTS OF FRUITS AND HOPS. By A. M. Massee, D.Sc., F.R.E.S. Pp. 294, $8\frac{1}{2} \times 5\frac{1}{2}$. (London: Crosby, Lockwood & Son, Ltd., 1937.) Price 15*s*.

For nearly thirty years the only comprehensive treatise on the fruit pests of this country available to growers has been Theobald's classical *Insect Pests of Fruits*. During this period important new pests have made their appearance in our orchards, much valuable knowledge has been amassed regarding others, and the methods of controlling the pests have been revolutionised. In this new work, therefore, Dr. Massee, the Chief Entomologist of the East Malling Research Station, has supplied a long felt want. It has been prepared essentially for the practical fruit-grower, and consequently technical descriptions of the insects have been omitted. Sufficient information is given, however, of the pests and of the damage they cause, to enable them to be recognised in the field, and the many excellent photographs will assist greatly in this respect. An outline of the life-cycle of each pest is given and an account of the latest methods of control. Reference to the subject-matter is rendered easy, not only by the full indexes to the scientific and popular names, but by the lists of the pests given at the beginning of each section dealing with the individual fruits. For those requiring further information the chief literature is quoted under each pest.

There are separate sections on beneficial insects, on insecticides and on spraying equipment and methods, the last named being contributed by J. Turnbull of the Ministry of Agriculture and Fisheries.

The book worthily takes its place as a successor to those of Miss Ormerod and Theobald, and should be in the hands of all concerned in the production of fruit, whether on a commercial scale or in the garden.

THE MANUFACTURE OF PULP AND PAPER. A Text-book of Modern Pulp and Paper Mill Practice. Volume III. Properties of Pulpwood; Preparation of Pulpwood; Manufacture of Mechanical, Sulphite, and Alkaline Pulps; Treatment of Pulp; Bleaching of Pulp; Testing of Pulp. Edited by J. N. Stephenson. Pp. xiii + 927, 9×6. Third Edition. (London: McGraw-Hill Publishing Co., Ltd., 1937.) Price 36*s*.

The lack of a thoroughly reliable and up-to-date textbook on the fundamental mathematical and scientific principles underlying the manufacture of pulp and paper, as well as on the actual operations involved in pulp and paper mill practice, suitable for students on the American Continent, was recognised some years ago by the leaders of the industry in both Canada and the United States. A Joint Executive Committee on Vocational Education, representing the pulp and paper

industry of these countries, was set up in 1918 and a scheme drawn up for the preparation of a suitable book. The result was *The Manufacture of Pulp and Paper*, in five volumes, first published in 1921. Vols. I and II dealt with mathematics, physics, mechanics, electricity, chemistry, etc.; Vol. III with the manufacture of pulp; and Vols. IV and V with the manufacture of paper.

A second edition of the volume now under consideration was issued in 1927, and during the ten years which have since elapsed developments in pulp manufacture have so fundamentally affected the industry that the text has had to be completely revised for this third edition. The sections on Soda Pulp, Sulphate Pulp, Bleaching of Pulp, and Testing of Pulp have been entirely rewritten, and extensive changes and additions have been made in other sections. This revision covers such subjects as stacking wood, pressing and drying bark, grinding wood, screening pulp, recovery of heat and acid in sulphite cooking, the use of acid-resistant steel, furnaces for heat recovery in alkaline pulp mills, refiners for recovery of pulp screenings, etc. The section on Properties of Pulpwood has also been thoroughly revised.

Two noteworthy features of the volume are the wealth of illustrations and the fact that not only is each section written by an expert on the subject, but the manuscript of each has been examined and criticised by several other competent authorities. The book, therefore, can be regarded as the last word on North American practice, and although, as already indicated, it has been prepared primarily as a textbook, it is in reality an indispensable reference work to all concerned in the pulp industry.

Synthetic Rubber. By W. J. S. Naunton, M.A., M.Sc., Ph.D., F.I.C., F.I.R.I. Pp. xvi + 162, 8½ × 5½. (London: Macmillan & Co., Ltd., 1937.) Price 7*s.* 6*d.*

The author of this work is head of the rubber laboratories of Imperial Chemical Industries, Ltd., and a large proportion of the book is devoted to the properties, technology, and uses of "Neoprene," a product of the firm. This, it is pointed out, is the only synthetic rubber generally available at present in Great Britain. At the same time an attempt has been made to cover, to some extent at least, all types of synthetic rubber. After an historical outline of the efforts to synthesise rubber leading up to the successful production of a chlorinated rubber, the author successively deals with the economic aspects of the subject, the relation between rubber and resins, and the chemistry, physics, technology, and applications of the synthetic product. A separate chapter is devoted to synthetic rubber latex. In the concluding chapter the "Future

Outlook " is discussed and the author expresses the opinion that when our knowledge has advanced sufficiently to connect the chemical and physical properties of the synthetic rubbers with their special characteristics it will be possible to design a synthetic rubber to meet particular requirements.

FOREST BIBLIOGRAPHY TO DECEMBER 31, 1933. Parts I and II. Compiled by the Department of Forestry, University of Oxford. Pp. i-xviii, 1-79, and 79-199, $9\frac{3}{4} \times 7\frac{1}{4}$. (Oxford: Department of Forestry, University of Oxford, 1936 and 1937.) Price, Part I, 5*s.*; Part II, 12*s.* 6*d.*

The compilation of this Bibliography was started in 1920 with a view to enabling the staff and students of the Oxford School of Forestry to keep in touch with the latest literature bearing on forestry. The authorities have earned the gratitude of all interested in the subject by deciding to publish the material in permanent form, of which two parts have so far been issued. The Bibliography comprises references to periodical literature published to the end of 1933 and contained in the library of the Department of Forestry; books are not included. The references to literature published in English are very comprehensive and much literature in French and German is also represented, but publications in other languages are omitted unless they contain summaries in English, French, or German.

The references are classified under subject headings, but it is proposed that everything published on and after January 1, 1934, will be arranged under the decimal system of classification prepared by Dr. Flury and adopted by the International Union of Forest Research Organisations. Part I includes references arranged under *A*, General Forestry, sub-divided under geographical sub-heads; and *B*, Silviculture, (1) General, (2) Seed and Seedlings; whilst Part II deals with the remaining sections of Silviculture, viz. (3) Natural Reproduction, (4) Artificial Reproduction, (5) Tending, (6) Silvicultural Systems, (7) Notes on Trees. References to journals are given first and then those to other periodicals, such as Bulletins, Annual Reports, reprints, etc., the arrangement under each section being chronological.

THE CYCLE OF WEATHERING. By B. B. Polynov, D.Sc. Translated from the Russian by A. Muir. Pp. xii + 220, $8\frac{1}{2} \times 5\frac{1}{2}$. (London: Thomas Murby & Co., 1937.) Price 10*s.* 6*d.*

Weathering and the production of soils are subjects which have attracted much attention of late, and the translator has performed a useful service in rendering Dr. Polynov's work more widely available.

The book opens with a review of the growth of philosophic thought leading up to the geological theories of Hutton and

Werner and the modern conceptions of the structure of the earth. Changes in the lithosphere are then described as being cycloidal in character, rather than cyclic, and it is pointed out that the zone of weathering is not only a zone in which chemical energy is dissipated but it is also one where cosmic energy is collected by biological processes.

In the second chapter, after dealing with the distribution of elements in the earth's crust, the author turns to the consideration of the formation, by bacterial agencies and inorganic reactions, of oxygen compounds such as carbon dioxide, carbonates, sulphates, nitrates, phosphates, and hydrated oxides. Other processes are then discussed, including the bacterial removal of oxygen from nitrates and sulphates; the hydration and solution of iron, aluminium, sodium, magnesium, and calcium minerals; the carbon chemico-biological cycle, of which a figure is given on p. 51; humus and peat formation; and the cyclic changes undergone by nitrogen and hydrogen.

The third and fourth chapters are essentially chemical in aspect and are concerned with the changes produced by the weathering of minerals containing silicon, aluminium and iron, the alkali and alkaline earth metals, chlorine, sulphur, and phosphorus. Special attention is given to Vernadsky's theory of the structure of the alumino-silicates, and to their alteration products.

In discussing the forms of crustal weathering in the final chapter the author advances the concept of three major cycles of denudation giving rise respectively to ortho-eluvium when the parent rocks are of a primary crystalline nature; para-eluvium when derived from sediments; and neo-eluvium when drifts are disintegrating. Within each cycle, phases of alteration conditioned by climate are assumed to take place, which progressively involve the removal of the chlorine and sulphur compounds, the loss of alkali and alkaline earth bases, the removal of silica from alumino-silicates, and the final accumulation and occasional transference of the sesquioxides of iron and aluminium. The transported or derived accumulations of detritus in each of the cycles are also said to be altered in a similar fashion, many examples of weathering said to be typical of the several classes being cited.

A short appendix summarising the literature on the structure of the silicate minerals, and useful subject and author indexes are included.

Les Ressources minérales de la France d'outre-mer. V. Le Pétrole. Pp. 263, $9\frac{1}{2} \times 6\frac{1}{4}$. (Paris: Société d'Éditions Géographiques, Maritimes et Coloniales, 1937.) Price 45 francs.

This publication of the Bureau d'Études Géologiques et Minière Coloniales, comprising ten chapters by various authors,

is concerned with the subject of petroleum generally and in particular with its occurrence in the French colonies.

The usual features of petroleum-bearing strata are dealt with in the first chapter which contains an account of the geosynclinal type of sedimentation often associated with oil deposits, and of the theories on the formation of oil pools advanced by Versluys, Illing, Van Mills, Munn, and Washburne. It describes the commoner geological structures in which oil has accumulated and gives examples with diagrams of some of those found in the United States, Poland, and Roumania, concluding with a brief summary of the chemical composition of various natural petroleums and the theories as to their origin.

The second chapter is devoted to the principles of oil-finding. After describing the usual indications of oil such as oozes, asphaltic residues, and natural gas, the author outlines the nature of the geological work necessary to establish the presence of favourable oil-bearing structures, and points out that the normal method of determining the age of strata by characteristic fossils often fails. In Madagascar, for instance, he was able to zone a series of marls only by the evolutionary features of a fauna of belemnites. Correlation of strata by heavy mineral assemblages receives special mention, and descriptions of tectonic and isopachyte maps, and methods of geophysical prospecting are also included. The chapter is illustrated by seven photomicrographs of thin sections of bitumen-bearing sediments.

The seven ensuing chapters are concerned with the work which has been done on the petroleum resources of Morocco, Algeria and Tunis, French Equatorial Africa, Madagascar, Syria, and other French possessions as well as Irak, the text being illustrated by several geological maps and sections.

The dependence of France upon foreign supplies of oil is stressed in the final chapter, which also includes a brief survey of the world sources of petroleum. The world production table on page 232, which compares the output of 1925 with that of 1934 would have been even more striking had later figures been chosen. It is noticeable that the author of this chapter has retained the old name for the Anglo-Iranian Oil Co., and that the name Persia is used on the map on page 225.

Short bibliographies are appended to many of the chapters, and, in addition, the book has two indexes, one of place names and the other of geological and mining terms.

PROTECTIVE FILMS ON METALS. By Ernest S. Hedges, M.Sc., Ph.D., D.Sc., A.I.C. Second Edition, revised and enlarged. Pp. xv + 397, $8\frac{1}{2} \times 5\frac{1}{2}$. (London: Chapman & Hall, Ltd., 1937.) Price 21s.

The first edition of this book, published in 1932, was

reviewed in this BULLETIN, 1932, **30**, 400, and the general remarks which were then made are still applicable.

During the last five years, however, considerable progress has been made in the practical application of protective films on metals, and in order to incorporate new matter the book has been extensively revised, and increased in size from 276 to 397 pages. The chapter headings, however, remain the same, except that the appendix in the first edition, on Paints, Lacquers and Enamels, has been expanded into a thirteenth chapter.

Changes in the new edition include an extended treatment of the anodic oxidation of aluminium and its alloys, and discussions of similar electro-chemical and chemical treatments for magnesium, zinc and tin; an account of tinplate manufacture and the hot-tinning of steel, copper, and cast-iron; a discussion of the properties of tin coatings and a review of recent work on their structure; and descriptions of the electrodeposition of bronze and rhodium, and of modern developments in electro-tinning.

Much of the additional information is of an industrial nature, and the book is designed to be useful both to scientists and to practical men concerned with the corrosion, protection, and decoration of metals in general, electroplating, tinning, galvanising, painting, lacquering, enamelling, etc.

It admirably fulfils these objects, and can be confidently recommended to all interested in the important subjects with which it deals.

THE ANALYTICAL CHEMISTRY OF TANTALUM AND NIOBIUM. By W. R. Schoeller, Ph.D. Pp. xvi + 198, $8\frac{1}{2} \times 5\frac{1}{2}$. (London: Chapman & Hall, Ltd., 1937.) Price 21*s*.

Up to comparatively few years ago the estimation of niobium and tantalum, their separation from one another, and from the rare earths and other of the less common elements, were operations which were performed by the most expert chemists without any real confidence in the accuracy of their results. The analytical chemistry of these elements was full of problems; the remarkable influence of titanium on the reactions appeared to be an unsurmountable difficulty, and there was an urgent need for systematic research into the subject. Dr. Schoeller and his collaborators valiantly stepped into the breach, and the results of their seventeen years' arduous labours are now collected and summarised in the present volume, for which many mineral chemists must have anxiously waited.

The book is divided into three parts. The first deals, *inter alia*, with theoretical considerations of importance in earth-acid analysis; with minerals containing niobium and tantalum; with manipulative details of the analytical technique; and

with methods for the analysis of earth-acid minerals, including a detailed account of the tartaric acid method evolved from these researches.

The second part deals with the quantitative separation, chiefly by new methods, of all the elements not removed as sulphides in the tartaric acid method. These elements include (as oxides) the earth-acids, dioxide earths, sesquioxide earths, beryllia, and tungstic and uranic oxides.

The third part comprises two chapters on the application of tannin in gravimetric analysis ; one on qualitative analysis, based on the lines of the quantitative procedure ; and one on the literature of earth-acid analysis.

The methods are clearly described, and though the system of cross references may appear somewhat involved, it is doubtless essential in order to avoid duplication and to keep the text within reasonable dimensions.

Chemists whose work leads them into this highly specialised and difficult branch of analytical chemistry owe a debt of gratitude to Dr. Schoeller for this outstanding and monumental research. He has revolutionised the analytical chemistry of niobium, tantalum, and their mineral associates, and to those who have occasion to analyse minerals and ores containing these elements the book is indispensable.

REAGENT CHEMICALS AND STANDARDS. By Joseph Rosin. Pp. ix + 530, 9 × 6. (London: Chapman & Hall, Ltd., 1937.) Price 30s.

The author of this book has had a considerable experience of the production of reagent chemicals. He is the Chief Chemist and Chemical Director of a well-known firm of manufacturing chemists, and has also served on a number of committees dealing with American specifications for high-grade chemicals. The book gives detailed consideration to the standards of purity to be reasonably expected from analytical reagents, and includes descriptions of a series of accurate tests for the impurities most likely to be present.

All the more common organic and inorganic reagents are considered, together with a number of others which are less common, including some of the recently introduced organic compounds used in testing for traces of metals. Where possible the tests recommended are quantitative and a method for the quantitative determination of each substance is described where practicable, the importance of this determination being stressed.

Modern research in analytical chemistry has increased the accuracy and sensitivity of existing methods and introduced many which are new, especially for the detection and estimation of substances in minute traces. The increasing purity of

reagents has made this analytical procedure possible, and if the methods of testing outlined in this book are used for a preliminary check of the quality of the reagents employed, the analyst, having determined their purity, will be able to record with confidence the presence of constituents which occur only in traces in the materials he may be required to examine. The book serves as a very useful guide to this essential and often neglected testing of reagents.

CHEMICALS IN WAR. By Augustin M. Prentiss, Ph.D. Pp. xviii + 739, 9 × 6. (New York and London: McGraw-Hill Book Co., Inc., 1937.) Price 45s.

Interest in the subject of chemical warfare has recently been revived in this country in connection with the organisation of national defence, and sensational articles have been published which grossly exaggerate the effects of war gases. Such publicity can have a very harmful effect on the public, and the Home Office, realising this, has published a series of handbooks giving an authentic description of the effects of such gases and recommending defensive measures.

A similar position has arisen in the United States, where Dr. Prentiss, who is one of the foremost American experts on chemical warfare, undertook, as a patriotic duty, to write a textbook on this subject. As the views which he expresses are his own and are not officially inspired, he is able to consider aspects of his subject which could not easily be mentioned in an official communication. He makes the fundamental, regrettable, but unavoidable assumption that chemicals will be used in any future war, in spite of international agreements to the contrary, and bases his arguments on this supposition.

The book is divided into five parts, the first two dealing with the scientific principles of chemical warfare and descriptions of the various chemicals, including smoke-producing agents and incendiaries, which were used or were about to be used, in the Great War. It is pointed out that some very active chemicals were not ready in time for use in the last war and have not been thoroughly tested, while others still more potent have probably been developed since, so that although the future of chemical warfare is difficult to assess, it is reasonable to assume that it will play a still greater part in any future war.

The third part of the book describes the technique and tactics of chemical warfare and is mainly of military interest. The author is incorrect in this section in saying that the first four companies of the Special Brigade, placed in action at the Battle of Loos in September, 1915, were armed with trench mortars. These troops made the first British discharge of gas from cylinders; the trench mortar attack was adopted at

a later date. The fourth part deals with the protection of the military and the civilian population, including a description of the development of the gas mask and protective clothing, methods of decontaminating areas, objects and buildings which have been contaminated with a persistent gas, and the provision of gas-proof rooms and shelters.

Certain general aspects of chemical warfare, such as its relationship to the chemical industry, are treated in the fifth part. The author points out the great value to Germany of her dye industry, which, at the outbreak of war, was producing over five-sixths of the world's output of dyes. With one or two exceptions the war gases were produced by this industry. Gases such as chlorine and phosgene, used in the earlier attacks, were large-scale industrial products before the war, while others were produced from intermediates which had been previously manufactured for other purposes. The British chemical industry made great headway during the war, but the difficulties of production are illustrated by the fact that in spite of every effort there was a lapse of over a year between the first use of mustard gas by the Germans and its production by the British.

If chemicals are to play an important part in future wars there are certain raw materials which will prove just as important for defence purposes as metals and explosives, and the possibility of an enormously increased demand for arsenic, phosphorus, chlorine or bromine, to take a few examples, will have to be foreseen and provided for.

The final chapters on the effectiveness of chemical warfare and the international situation are of considerable interest. The vexed question of the relative humanity of chemicals and explosives as warfare agents is examined thoroughly and decided to the author's satisfaction in favour of chemicals.

While this book is mainly written from a military point of view it should prove of great interest to chemists and to those engaged in the organisation of air-raid precaution services. Its two defects are the numerous minor, but irritating, misprints and the lack of any information as to the chemical detection of war gases, the latter omission being all the more remarkable in view of the author's emphasis on the importance for defence purposes of immediately detecting traces of such gases.

Dr. Prentiss's conclusions as to the possible effects of gas if used in air raids on the civil population are summed up in the following quotation: "All military experience with chemical warfare shows that gas can be effectively countered by organized protection. Confidence in this fact on the part of the general public, coupled with assurance that adequate protective measures have been provided, will go far towards

eliminating the threat of air-gas attack. Careful planning and preparation to this end must, therefore, appeal to and elicit the co-operation of every public-spirited citizen."

It is a cynical commentary on the present state of world civilisation that such books as these should be written, but the author is to be congratulated on producing a very interesting treatise on what might well be called " misapplied chemistry." It is, however, to be hoped that in some more enlightened age such works will be of historical interest only, and will be read with the same curiosity and aversion with which we now, very inconsistently, read of the barbarities of earlier civilisations.

BOOKS RECEIVED FOR NOTICE

CHISHOLM'S HANDBOOK OF COMMERCIAL GEOGRAPHY. Entirely rewritten by L. Dudley Stamp, D.Sc., B.A. Pp. xi + 884, 8½ × 5½. (London: Longmans, Green & Co., Ltd., 1937.) Price 25*s.*

THE COLONIAL OFFICE—A HISTORY. By Henry L. Hall, Ph.D. Pp. xii + 296, 8½ × 5½. (London: Longmans, Green & Co., Ltd., 1937.) Price 12*s.* 6*d.*

EUROPEAN BEGINNINGS IN WEST AFRICA, 1454-1578. By John W. Blake, M.A. Pp. viii + 212, 8½ × 5½. (London: Longmans, Green & Co., Ltd., 1937.) Price 10*s.* 6*d.*

IMMIGRATION INTO EASTERN AUSTRALIA, 1788-1851. By R. B. Madgwick, M.EC. (Syd.), D.Phil. (Oxon.). Pp. xii + 270, 8½ × 5½. (London: Longmans, Green & Co., Ltd., 1937.) Price 12*s.* 6*d.*

CROP MANAGEMENT AND SOIL CONSERVATION. By Joseph F. Cox and Lyman E. Jackson, Ph.D. Pp. xvii + 610, 8 × 5½. (New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd., 1937.) Price 13*s.* 6*d.*

POTASH DEFICIENCY SYMPTOMS. By Prof. Dr. Agr. h.c. Oskar Eckstein, Albert Bruno and J. W. Turrentine, Ph.D. Pp. xii + 235, including 54 coloured plates and descriptions, 9½ × 7. (Berlin: Verlagsgesellschaft für Ackerbau m.b.H.; London: Thos. Murby & Co., 1937.) Price 8*s.*

AGRICULTURAL MARKETING IN NORTHERN INDIA. By S. A. Husain, B.Com., Ph.D. Pp. 342, 8½ × 5½. (London: George Allen & Unwin, Ltd., 1937.) Price 15*s.*

FOOD PREPARATION. By Marion Deyoe Sweetman. Second Edition. Pp. xi + 449, 9 × 6. (New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd., 1937.) Price 15*s*.

MICROBIOLOGY IN THE PRESERVATION OF ANIMAL TISSUES. By R. B. Haines, B.Sc., Ph.D. Department of Scientific and Industrial Research, Food Investigation, Special Report No. 45. Pp. iv. + 85, 9½ × 6. (London: His Majesty's Stationery Office, 1937.) Price 2*s*.

KAFFEE: EIN LEHRBUCH IN ENGER ANLEHNUNG AN DIE PRAXIS. By Paul Ciupka. Pp. 77, 8½ × 6. (Hamburg: Otto Meissners Verlag, 1937.) Price 3·60 gold marks.

KAFFEE-SCHÄDLINGE UND -KRANKHEITEN AFRIKAS. By Prof. Dr. H. Morstatt. Pp. 119, 9 × 6. (Berlin: E. S. Mittler & Sohn, 1937.) Price 3·60 gold marks.

FRUIT ANNUAL AND DIRECTORY, 1937-8. Edited by H. F. Tysser. Pp. 355, 9½ × 6. (London: British-Continental Press, Ltd., 1937.) Price 10*s*.

DRUGS AND GALENICALS: THEIR QUANTITATIVE ANALYSIS. By D. C. Garratt, B.Sc., Ph.D., F.I.C. Pp. xiv + 422, 8¾ × 5½. (London: Chapman & Hall, Ltd., 1937.) Price 25*s*.

ANIMAL NUTRITION. By Leonard A. Maynard. Pp. xiv + 483, 9 × 6. (London: McGraw-Hill Publishing Co., Ltd., 1937.) Price 24*s*.

THE FEEDING OF FARM LIVE STOCK. By J. C. B. Ellis, M.A. Pp. 291, 8½ × 5½. (London: Crosby Lockwood & Son, Ltd., 1937.) Price 15*s*.

ELEMENTS OF FORESTRY. By Franklin Moon, B.A., M.F., and Nelson Courtlandt Brown, B.A., M.F. Third Edition, revised and reset. Pp. xviii + 397, 8½ × 5½. (New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd., 1937.) Price 17*s*. 6*d*.

FOUNDATIONS OF SILVICULTURE UPON AN ECOLOGICAL BASIS. By the late James W. Toumey, M.A., F.D., Sc.D. Second Edition revised by Clarence F. Korstian, M.F., M.A., Ph.D. Pp. xxi + 456, 9×6. (New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd., 1937.) Price 22*s*. 6*d*.

THE PRACTICE OF SILVICULTURE WITH SPECIAL REFERENCE TO ITS APPLICATION IN THE UNITED STATES OF AMERICA. By Ralph C. Hawley. Fourth Edition. Pp. xiv + 252, 9 × 6. (New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd., 1937.) Price 15*s.*

FOREST PROTECTION. By Ralph C. Hawley. Pp. ix + 262, 9 × 6. (New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd., 1937.) Price 13*s.* 6*d.*

TIMBER PRODUCTS AND INDUSTRIES. By Nelson Courtlandt Brown. Pp. xviii + 316, 9 × 6. (New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd., 1937.) Price 17*s.* 6*d.*

THE PROPERTIES OF BRITISH HONDURAS PITCH PINE (SLASH PINE)—*PINUS CARIBAEA* MOR. Department of Scientific and Industrial Research, Forest Products Research Records, No. 20 (Timber Series No. 6). Pp. 9, 9¾ × 6. (London: His Majesty's Stationery Office, 1937.) Price 6*d.*

METHODS OF BENDING WOOD BY HAND. By W. C. Stevens, M.A., A.M.I.Mech.E., and N. Turner. Department of Scientific and Industrial Research, Forest Products Research, Bulletin No. 17. Pp. ii + 9, 10¾ × 6. (London: His Majesty's Stationery Office, 1937.) Price 1*s.*

OUTLINES OF HISTORICAL GEOLOGY. By Charles Schuchert and Carl O. Dunbar. Third Edition, entirely re-written. Pp. v + 241, 9 × 6. (New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd., 1937.) Price 12*s.* 6*d.*

ECONOMIC GEOLOGY. By H. Ries, A.M., Ph.D. Seventh Edition. Pp. 720, 9 × 5¾. (New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd., 1937.) Price 25*s.*

INTERNATIONAL CONTROL IN THE NON-FERROUS METALS. By William Yandell Elliott, Elizabeth S. May, J. W. F. Rowe, Alex Skelton and Donald H. Wallace. Pp. xxi + 801, 9½ × 6½. (New York: The Macmillan Company; London: Macmillan & Co., Ltd., 1937.) Price 28*s.*

EFFECT OF IMPURITIES IN COPPER. By S. L. Archbutt, F.I.C., and W. E. Prytherch, M.Sc. Pp. xvi + 134, 9¾ × 6. (London: British Non-Ferrous Metals Research Association, 1937.) Price 12*s.* 6*d.*

STATISTICAL YEAR-BOOK OF THE WORLD POWER CONFERENCE, No. 2. Data on Resources and Annual Statistics for 1934 and 1935. Edited, with an Introduction and Explanatory Text, by Frederick Brown, B.Sc., F.S.S. Pp. 132, 11 × 8½. London : The Central Office, World Power Conference, 36 Kingsway, W.C.2, 1937.) Price 20*s*.

AKTIVE KOHLE UND IHRE VERWENDUNG IN DER CHEMISCHEN INDUSTRIE. By Dr. G. Bailleul, Dr. W. Herbert, Dr. E. Reisemann. Pp. 114, 10 × 6½. Second Edition. (Stuttgart : Ferdinand Enke Verlag, 1937.) Price R.M. 8.

POLYMERIZATION AND ITS APPLICATIONS IN THE FIELDS OF RUBBER, SYNTHETIC RESINS, AND PETROLEUM. By Robert E. Burk, Howard E. Thompson, Archie J. Weith and Ira Williams. Pp. 312, 9 × 6. (New York : Reinhold Publishing Corporation ; London : Chapman & Hall, Ltd., 1937.) Price 37*s*. 6*d*.

CATALYTIC PROCESSES IN APPLIED CHEMISTRY. By T. P. Hilditch, D.Sc., F.I.C., and C. C. Hall, M.Sc., Ph.D., A.I.C. Pp. xxii + 478, 8½ × 5½. Second Edition. (London : Chapman & Hall, Ltd., 1937.) Price 25*s*.

SELECTED TOPICS IN COLLOID CHEMISTRY WITH ESPECIAL REFERENCE TO BIOCHEMICAL PROBLEMS. By Ross Aiken Gortner. Pp. xiii + 169, 9 × 6. (New York : Cornell University Press ; London : Humphrey Milford, Oxford University Press, 1937.) Price 11*s*. 6*d*.

VOL. XXXV 1937

INDEX

Scientific names and titles of books are printed in italics and personal names in capitals